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ABSTRACT

This book contains a record of papers and edited transcripts presented at a program sponsored by the Institute for Environmental Studies. The program was part of an International Exposition on the Environment, EXPO 74 held in Spokane, Washington. The program incorporated three areas of interest: designing and finding methods for improving environmental education at all levels of learning including professional educators, civil servants, elected officials, industrial representatives, students, and citizens; special sessions on water quality education for members of the Environmental Protection Agency Advisory Committee; and special sessions on the management of large-scale interdisciplinary research projects for educators involved in a National Science Foundation grant. The general sessions included speeches on university and secondary programs, international programs, political views, and financing. The special sessions covered topics in water quality education, curriculum, research, and public service. (Editor/MR)

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PROCEEDINGS

LEARNING FOR SURVIVAL:
A SYMPOSIUM ON ENVIRONMENTAL EDUCATION AND WATER QUALITY FOR THE FUTURE

OCTOBER 25 - 27, 1974

**INSTITUTE
FOR
ENVIRONMENTAL STUDIES**

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Proceedings

LEARNING FOR SURVIVAL:
A SYMPOSIUM ON ENVIRONMENTAL EDUCATION
AND WATER QUALITY FOR THE FUTURE

October 25 - 27, 1974
Davenport Hotel - Spokane, Washington

Sponsored by the Institute for Environmental Studies
University of Washington, in Cooperation with
EXPO '74

Edited by Ann Widditsch

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Environmental Protection Agency Office of Water Programs

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FOREWORD

During the period of May - October, 1974, an International Exposition on the Environment, EXPO '74, was held in the city of Spokane, Washington. Because of its environmental theme, and as part of our public service effort, the Institute for Environmental Studies at the University of Washington was interested in providing some environmental contribution to the fair as well as assisting Spokane in its efforts. This interest was realized early in 1974 when it was learned that a series of international environmental symposia was planned, and that the U.S. Environmental Protection Agency was willing to help support this effort through a grant to be administered by the University.

The grant was received, and partial support was provided for three EXPO '74 sponsored symposia, as well as full support for one symposium to be sponsored by the Institute:

"The Dilemma Facing Humanity", May 1974, EXPO '74

"Environmental Accomplishments to Date: A Reason for Hope", July 1974, EXPO '74

"Creating the Future: Agendas for Tomorrow", October 1974, EXPO '74

"Learning for Survival, A Symposium on Environmental Education and Water Quality for the Future", October 1974, University of Washington

Financial as well as planning support for the Learning for Survival Symposium was provided by staff of the Environmental Protection Agency; and the Battelle Memorial Institute, through the Battelle Research Center and the Battelle Pacific Northwest Laboratories, Richland. The Advisory Committee listed elsewhere assisted in planning for the Symposium.

There were three principal thrusts or objectives, all with related interests, that were incorporated concurrently into this Learning for Survival program. The largest portion of the program was developed for those interested in designing and finding methods for improving environmental education at all levels and stages of learning; professional educators, civil servants, elected officials, industrial representatives, students and citizens. Water quality, as an example of environmental concern, helped by providing a unifying theme. Special sessions on water quality education were held concurrently and specifically for members of the EPA

Advisory Committee on Water Quality where attendance was open to all symposium participants.

Additional special sessions were held for educators involved in a National Science Foundation supported grant through the University on the management of large-scale interdisciplinary research projects, where the improved management of environmental research is one of the principal areas of concern. Additional financial support to participants was provided by EPA for the Water Quality Advisory Committee and by the NSF grant for its participants. Key planning assistance for these concurrent sessions was given by Robert Ruhl and Bernard Lukco of EPA, and Donald Bevan and Brian Mar and Donald Baldwin of the University.

The symposium was successful in meeting its objectives, thanks to the Advisory Committee, the planners of the concurrent sessions and the participants. We hope that readers will find these proceedings of value in developing and conducting their environmental study programs.

Robert O. Sylvester
Director
Institute for Environmental Studies
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EDITOR'S PREFACE

These proceedings are a record, somewhat condensed, of what took place at the symposium. The final program is incorporated in the table of contents. Because of the many concurrent sessions, no one participant could attend all of the symposium; the proceedings now provide that opportunity.

Papers as submitted by speakers are included, and edited transcripts are used where manuscripts were not available. The entire symposium was tape recorded, except for a few instances where recorders failed (to our regret). Where material is based on transcripts, we have done our best to capture the intent of the speaker. No attempt has been made to bring facts up to date.

In the case of the discussions among panelists and participants, we have tried to capture the flavor without verbatim transcription. Relevance, usefulness and interest were our standards for including discussion, rather than consistency. Where speakers could readily be identified, they have been. If any errors have been made in these identifications,we apologize. Sometimes discussions that took place at various times during a session have been consolidated. We hope that the final result will, however, still sound familiar to those who took part.

Responsibility for all decisions regarding arrangement and inclusion of material rests with the editor.

Ann Widditsch

ACKNOWLEDGEMENTS

We are grateful to the Environmental Protection Agency for its financial support and planning assistance, and to Battelle Memorial Institute and the National Science Foundation for additional financial assistance. The Advisory Committee listed on pages xiii - xiv helped in many ways in planning and carrying out the Symposium.

Robert O. Sylvester, Director of the Institute for Environmental Studies, provided help and encouragement from the conception of the idea of the Symposium to the final publication of the proceedings. Nothing would have been possible without the wholehearted support and enthusiasm of the staff of the Institute, especially Alice Shorett, Carol Schmidt, Betty Hofeditz, Lynn Leonard, and Ed Sheets.

The EXPO '74 Symposium staff, including especially Cindy Eymann, Denelle Blangeres, Don Jensen, and Robert Stilger, provided indispensable support.

Thanks to our many excellent speakers whose wisdom, enthusiasm, and questioning made the Symposium a stimulating experience for the participants -- to whom we are also grateful for their lively interaction.

Finally, thanks to Bob Widditsch, who furnished 100 pounds of fresh Washington state apples for the participants.

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Session 1

SETTING THE FRAMEWORK:
A PHILOSOPHICAL PERSPECTIVE ON ENVIRONMENTAL EDUCATION

Ruth C. Clusen

When I look back nearly 20 years to the time when the League of Women Voters of the United States first decided to undertake work on water resources, I realize how much has changed since then--from all perspectives. Later than some, but earlier than most, we realized the growing need for public education and action on a whole spectrum of related issues on the total environment.

In the two decades since we began on water resources we have come a long way--but not nearly far enough. I speak not from the vantage point of what should be contained in an academic curriculum specifically, although the League's long and close association with the academic world has given us some insights into this. Rather, I speak of what it seems to me the public needs to know in order to meet the new environmental challenges. Perhaps this talk might be more aptly titled, "What citizens need to know that the books don't tell." I hope you find in it some assistance, based on broad experience, in seeking answers to how best to "learn (and teach) for survival" in the next 20 years.

There was so much we did not know when it all began (and I use "we" to mean concerned citizens, not just the League). We did not, for example, fully comprehend the dimensions of environmental problems or that it was impossible to look at water resources management, or at air quality, and not solid waste management, and land use planning. We gave only lip service to the incontrovertible fact that, as causes, social justice and pollution abatement are not natural allies. Nor did we really believe that physical problems are international. Indeed there was even a tendency to deal with them in this country on a community or state-wide basis.

We did not realize how much we needed to know and that a lot of it we could not get simply from the media and popular pieces. No one told us that we had

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Ruth C. Clusen, of Green Bay, Wisconsin, is President of the League of Women Voters of the United States, having served on the League's national board since 1966. She was an official observer at the United Nations Conference on the Human Environment, in Stockholm, June 1972; is a member of the Environmental Protection Agency's Technical Advisory Group on Wastewater Treatment, and has been an environmental consultant to many other agencies and groups.

to be not only environmentalists but engineers, lawyers, economists--and, most of all, politicians. We sallied forth, secure in the knowledge that our cause was just--to tackle industry, business, government, and an apathetic and uninformed public--armed only with a few basic facts and figures and a crusader's zeal. We naively believed that if we could just arouse and inform the public, make sure that decision-makers really understood the problems, they would see the light. What amazes me now is not that we accomplished so little--but that we gained so much, with so little ammunition.

Obviously circumstances have changed and with the change comes a new and deeper realization of the kind of environmental education essential to sustain some of the progress made and to move forward again. This understanding, I think, is the true challenge of "learning for survival"--the theme of this conference. Therefore, I should like to suggest to you some of the things it seems to me we all need to perceive, whether we are professional or layman, student or teacher, if we are to survive.

In the last half of the 70's, I see at least four basic concepts which are absolutely essential in helping people to cope with a changing environmental climate. With no particular priority these are:

1) understanding of the relation between economics and environmental needs;
2) sophisticated knowledge of legislation, including regulations, guidelines, standards;
3) more emphasis on improving the urban environment;
4) a global view of environmental problems.

As we look back over the past 18 months, there can be little doubt that environmental programs have become the scapegoat for both rising inflation and the energy shortage. Those who work for improved environmental quality can't possibly parry the attacks on government or private programs without a pragmatic understanding of the close relationship between the environment and economics. It is not enough either to stubbornly maintain there is no correlation or to have only a superficial knowledge. In fact, economic effects are where the action is now. Regression or progress depends on our ability to cope with economics.

I find reassurance in a recent statement by Environmental Protection Agency Administrator, Russell Train, that "Environmental expenditures are not a significant factor in the present inflation and are not to any significant degree responsible for the capital squeeze." He also noted that all available evidence suggests that the benefits of pollution control expenditure far exceed their costs. According to the latest Chase Econometrics Associates forecasts, pollution control programs will cause an average annual inflation rate of about 0.3 percent for the period 1973-78 and an average annual rate of 0.2 percent for

1973-82. The Chase Study also forecasts that between 1973-82, pollution control will result in a negligible average increase in the rate of unemployment.

Nevertheless the process of environmental budget cutting goes on. In Congress a pending bill that would reduce EPA's fiscal '75 operating budget to $642 million from the $672 million previously authorized seems destined to pass both Houses. This cavalier attitude, plus the long impoundment of funds for waste water treatment construction, lays bare the unconscionable attempt to reverse or delay programs endorsed by most of the Congress and a large part of the public.

Over the past few years there has grown a general recognition of the importance of economic analysis in the development and implementation of sound environmental policies. The essence of the economists' message is that any goods or service, whether a new automobile or cleaner air, costs something. Having decided that environmental quality is a valuable goal, we now have to decide more precisely how much we want, how we will pay for it and who will pay for it. Those decisions, especially in a complex economic situation, often require complicated analyses involving difficult trade-offs. A sound background in estimating cost effectiveness in relation to goals is now more essential than ever to environmental education.

The second factor which seems to me imperative is the capacity to undertake a more thorough and comprehensive look at legislation, and to go beyond authorization to implementation procedures and executive and administrative orders. It is no longer enough to be involved only in the passage of legislation. Laws tend to be written in general language; standards and regulations are detailed. Guidelines for the application of the law may enhance, reduce, or modify its original intent. If people concerned with environmental issues cease their efforts when laws are passed, the real gut issues will be decided by others.

We must learn to deal with proposed rule-making, how and when to have most effective input, how and when to react most intelligently to criteria and standards, and to environmental impact statements. The latest addition to the list is the "inflation impact" statement, which is now, by order of the President, to be attached to any new regulatory proposal from the Executive Branch. Who will watch that other values, non-economic, will receive equal weight? Who will be prepared to analyze inflation impact statements to ascertain their true relevance and meaning?

There was a time when the League of Women Voters used to tell its constituency that they need not be experts to appear at hearings. We were given to saying that citizens should learn the basic information, decide what they wanted, and go down and testify. It worked then--but it won't work now. The changing nature of the governmental role and the great body of environmental legislation passed in the last decade make it necessary for citizens to do much more than make general statements. Now we need to understand technical terminology, to know if a degree of difference in temperature standards represents degradation, to analyze and select from many legislative proposals those that will really accomplish our goals. Now to be really effective we must know more and follow through the entire process.

One of the growing gaps in most environmental education curricula seems to be the artificial separation of traditional natural resources courses from urban-oriented planning courses. Americans have been very slow to grasp that physical environment means both natural and human and that when we speak of a "quality" environment we have to be talking about urban areas, too. In the real world of city planning and natural resource management, this is recognized more often in the breach than in the observance. For the most part city planners still plan for urban areas, and natural resources managers still concentrate on open space, preservation, pollution abatement and recreation, with only an occasional foray into each other's territory.

Two of the most important environmental facts of life are that 12 percent--some say 22 percent--of the population of the United States is poor, and that, by and large, the poor are getting the worst of it as far as environmental pollution is concerned. The nation's poverty areas have their own discouraging environmental characteristics, and the urban poor are trapped in them. Of course, legislation and technical assistance programs dealing with air and water pollution, noise, workers' safety, toxic substances, rats, etc., can and have helped to alleviate some of the environmental degradation of the poor. Nevertheless, the poor don't see themselves as involved in environmental concerns, and inner city people have a feeling of hopelessness about constructive change.

One of the greatest contributions which environmental education could make would be to focus on how to identify and suggest solutions for urban areas where there is little or no awareness of physical environmental dangers and where there is antagonism toward those who choose the urban environment as their cause. Urban dwellers do not identify with environmentalists; they don't see their unhealthy surroundings as environmental problems; they are unaware or frustrated by the seemingly insurmountable difficulties of getting a handle on the funds and advice needed to help them.

Environmental education must play a difficult but vital role in urban areas, a role by no means fully realized as yet. Much more time and effort must be devoted to showing an interest in and knowledge of urban environments' beyond the cosmetic and superficial attack now being made. Senator Gaylord Nelson has suggested that poverty and pollution have "common roots". An education which largely ignores those common roots of ignorance and indifference does so at its own peril.

To broaden the environmental constituency in an urban age, organizations and institutions concerned about the quality of man's natural environment must seek and win the confidence of the urban power structure and of inner city residents. Environmentalists must demonstrate how the relevance of their interests and skills can alleviate city problems. One of the basic truths which must be dealt with is that environmentalists cannot be effective so long as they seek urban environmental improvement in ways that penalize the poor for a situation they did not create.

Without adequate attention to and understanding of the tremendously complex urban environmental problems by those who are both perceptive and informed, much of the base of public support for environmental quality, which built up in the 60's, will disappear in the 70's.

The late 60's and early 70's marked a major turning point in the priority given to the environment on the international scene. Before then, environmental protection received little attention in the domestic programs and international relations of most countries. International environmental cooperation was a rarity and agreements between nations to address shared problems were virtually unknown. As one decade became another there was an explosion of environmental interest and activity in a number of nations. The 1972 United Nations Conference in Stockholm stimulated a spirit of global cooperation which continued this year in conferences in Caracas on the Law of the Sea, in Bucharest on Population, and will focus next month in Rome on food.

However, the aura of good will has been dimmed considerably by the events of last winter and this summer. We must see the possibility of world-wide shortages and the growing realization that cooperation is being replaced by competition. The oil embargo of a year ago pointed out more clearly than words ever could both global interdependence and the growing use of resources as political weapons. While international cooperation for environmental protection still goes on to some extent, it is unrealistic not to face squarely the fact that it is imperiled by the lack of a global perspective toward the earth's resources.

Environmentalists did not start the Arab-Israeli War or make us dependent upon Arab oil. Nor did they cause the climatic conditions that have brought us to the brink of a world-wide food shortage. In fact, environmentalists have warned for years that the course we were pursuing would lead to the situation we now face. Obviously we did not yell loud enough or reach the right ears, or use the most effective tactics--because few governments listened. How ironic it is that we who gave early warning should now be the villains of the future we foresaw.

There are lessons to be learned from this denigration. Whether you belong to the "short-term" school of thought which believes that tightening our belts and voluntary conservation programs will get us over the hump, or subscribe to the "long term" school which thinks the only hope lies in fundamental changes in life styles, is immaterial. What does matter is that in order to make progress we need to work on both the demand and supply ends--by offering appropriate incentives, by institutional inventiveness, by education, by example-setting--and from a global point of view.

Even as environmental improvement in the united States depends upon responsible institutions and adequate legal authorities, so is the same true in the international arena, although providing the infrastructure would be somewhat more difficult. There has been progress in creating institutions and a body of international law necessary for global cooperation. New institutions have been formed and old ones reorganized. The world community is moving forward to adopt necessary legal authorities to control pollution, direct development and preserve the world's heritage.

Today concentration on cooperation should bring forward the hard questions like the impact of environmental standards on the balance of trade and development of adequate cost data on the effects of economic growth on pollution abatement costs. Far from resolution are questions about prospects for easing food supply problems or for approaching the limits to expansion of agricultural output. There is a growing demand in the United States and abroad that the food problem be perceived and treated as one that calls for world-wide cooperation rather than a bilateral or internal adjustment. Hopefully the Food Conference in Rome in November will point the way--not with rhetoric but with deeds.

As with domestic resource problems, the most important force for international action is broad public demand and interest. The sooner we stop looking on the world's environmental problems in a narrow sense and focus instead on the global resource shortage in the broadest sense, the better the chance that we just might find solutions before we are engulfed by a rising tide of such crises.

The energy crisis of 1973 seems to have been replaced by the economic crisis of 1974, but both point up the hard choices we face between alternative uses of our natural world, when one kind of exploitation or enjoyment interferes with another, in some places choices between exploitation in general and environmental integrity. The purpose of education should be to help us learn how to cope with hard choices with knowledge and intelligence. We do not need an environmental education per se--we need an education in economics, we need an education in social justice, we need a political education, we need a global education which sees beyond pollution and preservation. The challenge to environmental educators and citizens now is to merge these needs, and many other elements, into an education for survival in this century and the next. The program for this seminar has recognized the necessity for an inter-disciplinary approach--more power to you.

We hear a great deal nowadays about the importance of standing up and being counted on a variety of issues. Environmentalists cannot afford the luxury of sitting back and contemplating the progress of the past two decades--or of standing up and being counted on behalf of time-tested environmental causes. Over 100 years ago, Oliver Wendell Holmes said, "I find the great thing in this world is not so much where we stand, as in what direction we are moving .... We must sail sometimes with the wind and sometimes against it. But we must sail, and not drift, nor lie at anchor." I commend this philosophy to you as you seek the answers to learning for survival.

7/8

NOTES ON THE "NEW VIRGINIA": THE AMERICAN LAND IN PLANNING FOR THE FUTURE

David G. Barry

The images of the American land, particularly those of the American West, are complex and multi-faceted. This has been so since the first European white men landed on eastern shores. They were confronted by a new and strange environment, one which contained plants and animals never before known or seen in Europe....tobacco, maize (corn), round potatoes, pumpkins and squash, and "round-horned" elk, the jaguar, cougar, raccoon and opossum to name a few. These images have changed with different periods in our history, varying as our information and experience with the American land have varied. Americans have alternately been seduced by the land in times of apparent bounty and abundance, and through ignorance, avarice, or misinterpretation, have been destroyed by it in times of over-exploitation, devastation, drought and scarcity. Although such hard times have bred bitterness, disillusionment and alienation from the land, our attention has always returned to it as a force which perhaps more than any other has determined our personal values and images and given shape to that American culture evolving from our first colonial experiences.

In the 1840's Alexis De Tocqueville foresaw the eventual impact of the vastness of the American landscape on human experience and response. Caught up in the westward expansion and change as he was, he recognized that the time would come "when one hundred and fifty million men would be living in North America all belonging to one family". The rest he said "was uncertain". It is fair to say that De Tocqueville well anticipated the "uncertainties" that have resulted in our relations with the land, relations which will be under serious consideration in the Bicentennial year, 1976, when our pupulation will have well exceeded 200 million persons.

Thoreau also spoke with a deep concern for the American land and the West. "Eastward I go only by force; but westward I go free." This was the man who said, "My needle is slow to settle....varies a few degrees and does not always

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point due southwest, it is true, and it has good authority for this variation, but it always settles between west and south-southwest. The future lies that way to me, and the earth seems more unexhausted and richer on that side."

Forty years later, the Englishman, James Bryce, carried the image still further in the American Commonwealth when he wrote, "For the West is the most important part of America; that is to say, the part where those features which distinguish America from Europe come out in strongest relief."

There was both myth and substance in these images. In the West did lie the great vast lands of America. The image of the beautiful "paradise garden" and the myth of manifest destiny were the foundations on which the agrarian society was built--first on the eastern shores and in the South, then moving into the Mississippi Valley and onto the Great Plains, and then leaping across the mountains into the Valley of the Great Salt Lake; the Southwest; the valleys of California and the Willamette, the Columbia and Puget Sound....pressing beyond the continental United States to Alaska and Hawaii. Only now do these myths and images come into perspective with the realization that there are no more free lands to the west. We have reached the end of our tether and must make do with what we have.

One of the first Americans to recognize the potential influence the land would exert on American culture was Thomas Jefferson. He struggled to break bonds with European images and wrote what William Peden has called, "the most important scientific and political book written by an American before 1785", Notes on the State of Virginia. Long before De Tocqueville, Thoreau and others spoke enthusiastically about the West, Jefferson, the American environmentalist, had spoken his mind clearly. As we approach our country's Bicentennial, we will see his views on land ever provocative and central in the development of our culture. Jefferson raised many issues about the land and our nation that remain unresolved. It was his intention then (as it is ours today), "....to utilize knowledge of the past to remedy present injustices and to help prepare for a better future." What greater meaning and purpose can there be for the American Bicentennial year than to reaffirm that commitment which Jefferson gave for the writing of his Notes on the State of Virginia?

He began with an "exact description" of the boundaries of Virginia--the largest state in the Confederation--claiming territory close to one-third the area of the continent, land later to be subdivided into numerous states. He estimated that the "boundaries include an area somewhat triangular, of 121,525 square miles, whereof 79,650 lie westward of the Allegheny mountains, and 57,034 westward of the meridian of the mouth of the Great Kanhaway. This state is therefore one-third larger than the islands of Great Britain and Ireland, which are reckoned at 88,357 square miles." Its size and extent alone were enough to supply him with "an irrestible impulse into the vastness of the West." A scant 15 years later Jefferson became the President of the United States who authorized and promoted the Lewis and Clark Expedition, the first to penetrate the western lands and reach the Pacific shores.

Notes on the State of Virginia was a controversial book because Jefferson expressed the American belief that in this new land man could test his ideas about liberty and justice, hopefully to improve the human condition. Jefferson used facts as a means to an end. His work which began with an inclusive compilation of data led to speculations on inherent social, political and moral implications. With an almost mystical belief in American destiny, linked with an amateur scientist's awareness of the vast spaces and the unexplored natural resources that this continent held, Jefferson conceived the idea of an "empire of liberty". William Peden in his introduction to a 1955 edition of the Notes identifies some of the continuing human issues Jefferson raised which were central to the new and struggling nation and which remain central to the nation as we approach our Bicentennial:

> In his Notes on Virginia, Jefferson at one time or another criticizes most of the vested interests of his time. He attacks the assumption and usurpation of power by the rich, the powerful and the well born; the tyranny of the church; the dogmas of the schoolmen; the bigotry of the man on horseback; the enslavement of man by man; the injustice of racial superiority. Specifically, he questions such matters as the origin of shell (mollusc) formation, rejects the theory of the universal deluge, and disagrees with the pontifical statement of Buffon (the French zoologist) concerning the degeneracy of animal life in the new world. Specifically, he argues for the need to educate all those who have the capacity to learn, regardless of their social or economic status. Specifically, he attacks those legislators who would overthrow a foreign king only to replace him with a native dictator. But his ultimate goal was always essentially the same ....the right of the individual to freedom and happiness under just and equitable law.

Moreover, holistic American environmentalist that he was, Jefferson countered the Count de Buffon's assertions that the American environment had a negative and limiting effect on all living things that it touched. Buffon believed

1. That the animals common both to the old and new world, are smaller in the latter.
2. That those peculiar to the new are on a smaller scale.
3. That those which have been domesticated in both, have degenerated in America.
4. That on the whole it (America) exhibits fewer species.

Methodically, with carefully prepared facts and analysis, Jefferson defended the American land and set Buffon's opinions aside.

He countered Buffon's derogating descriptions of Native Americans, highly complimenting the Indians' bravery, industry, intelligence, capacity for family loyalty and friendship, and dignity and eloquence in aural history and persuasion. In defending the geographic dispersal of the Indian tribes into small bands, he came close to identifying the ecological concept of the "carrying capacity of the land" which necessitates such dispersal in a hunting society, but not in an agrarian society where intensified cultivation can produce more food per acre. However, this idea was not clearly identified and understood until after the American Centennial Year when the ecological concept was given a clearer shape and form by Darwin and the biologist Haeckel. Jefferson spoke critically of early American efforts to till the soil when he said, "The indifferent state of that among us (agriculture) does not proceed from a want of knowledge merely; it is from our having such quantities of land to waste as we please. In Europe the object is to make the most of land, labour being abundant; here it is to make the most of our labour, land being abundant."

Jefferson attributed the bounty of the American land to a bountiful God. The continent was largely unexplored and where it was settled, the main images in the landscape were the results of the work of the Creator: weather, animals, plants, soils, minerals and flowing waters. The power man needed for his work came from the horse and the waterfall. Eventually, with the advent of the machine and industrialization, the transplanted European caused displacements in the Jeffersonian world of agrarian nature by the creation of his own environments from steel, concrete and plastic.

However, before that transition occurred, the values held by an agrarian society led to a confrontation with those of the Native Americans. The values of the former found their authority in biblical assurances that Christian Man was a creature separate from nature vested with the potential for dominion through Manifest Destiny over all things on earth; in contrast, the values of the latter were derived from the residual wisdom of generations of life experience that recognized man as a creature among creatures, as a part of and responsible to natural cycles of events in the ecosystems* of the American landscape.

The differences in first assumptions and points of view of the Native American red man and the white man toward the American land had different consequences in shaping the form and the action of their lives and cultures. One difference was stated clearly by John Quincy Adams in 1820 when he said of the Indians, "Their cultivated fields, their constructed habitations, a space of ample sufficiency for their subsistence, and whatever they had annexed to themselves by personal labor, was undoubtedly by the law of nature, theirs. But what is the right of a huntsman to the forest of a thousand miles over which he has accidentally ranged in quest of prey?" (From History of the People of Iowa, by Cyrenus Cole.)

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* As used in this paper an ecosystem is a recognizable, coherent unit of the landscape composed of living things: plants; animals; and man; environmental factors: climate; temperature; earth; air; and water; and their interactions one upon the other over time.

Adams' question was rhetorical. He did not seek an answer. The question implies a fundamental difference in view between the red and the white men, hunters and farmers. The hunter was part of a dynamic ecosystem which required hundreds, even thousands of square miles to generate adequate food for self and family. Adams' view was that of the agriculturalist, the husbandman from Europe where "by definition" man "possessed" the land and "used" the land, forcing his will through intensive agriculture upon the natural ecosystems.

These alternative definitions and understandings defined differences in assumed "human rights" which later led to extreme confrontation between the red man and the white man in the American land, each considering the other to be mistaken and unyielding as he pressed his point of view. Extending the argument of John Quincy Adams, it would follow that the processes by which the men from Europe acquired the lands from the Native Americans were appropriate and just. According to the white man, these lands were not "being used" in the sense of European agriculture, and as such were unclaimed wilderness lands, free and available for conversion to support their own human needs. This fundamental difference in viewpoint grew and became a barrier to communication, a barrier present even today.

Chief Luther Standing Bear of the Lakota tribe of the high plains ecosystem (called Sioux by the French) clarifies another difference in the thinking of the white man and the red man when in his autobiography, Land of the Spotted Eagle, he describes the attitudes of the Native American toward the land:

> The earth was full of sounds which the old-time Indian could hear, sometimes putting his ear to it so as to hear more clearly. The forefathers of the Lakota had done this for long ages until there had come to them real understanding of earth ways. It was almost as if man were still a part of the earth as he was in the beginning.

This attitude was the basis for the association of the Lakota hunting culture with the things of the earth, with the natural environment.

> From Wakan Tanka (The Big Holy, the maker of the earth, sky and water) there came a great unifying life force that flowed

> in and through all things....the flowers of the plains, blowing winds, rocks, trees, birds, animals....and was the same force that had been breathed into the first man. Thus all things were kindred and brought together by the same Great Mystery.

Such a basic assumption about natural ecosystems, when treated as a "real and active principle", supported a kinship of equivalency among all creatures of the earth, sky and water, quite in contrast to the view of the white man who held "dominion" over all other elements of nature. For the Indian, knowledge was inherent in all things. On the surface, this was a view similar to that of the early New England Puritan who studied Natural Theology that he might better know the Creator, to know the designer through the study of his design.

But, there was a marked difference in interpretation. Certain extremes in the "Book of Nature" were thought of as "punishments" for man by the New England Puritan. For the Native American, "through study of the 'library of nature' and its books: the stones, leaves, grass, brooks, and the birds and animals that shared, alike with us, the storms and blessings of Earth, the Indian learned to 'feel Beauty'". The Native American considered himself an integral part of the land ecosystem. As Standing Bear of the Lakota puts it:

> We never railed at the storms, the furious winds, and the biting frosts and snows. To do so intensified human futility. So, whatever came, we adjusted ourselves, by more effort and energy if necessary but without complaint.
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> We did not think of the great open plains, the beautiful rolling hills and winding streams with tangled growth as "wild". Only to the white man was nature a "wilderness" and only to him was the land "infested" with wild animals and savage people. To us it was tame. Earth was bountiful and we were surrounded with the blessings of the Great Mystery. Not until the hairy man from the east came and with brutal frenzy heaped injustices upon us and the families we loved was it "wild" for us. When the very animals of the forest began fleeing his approach, then it was that for us the "wild west" began.

These differing definitions led the red and the white men along different paths. Standing Bear said, "The Indian and the white man sense things differently because the white man has put distance between himself and nature; and assuming a lofty place in the scheme of order of things has lost for him both reverence and understanding" of nature and the land around him.

The white man came from a Western Christian tradition that defined the Wildness of Nature in contrast to the delicate beauty of the Garden of Paradise. Lord Kenneth Clark in his work, Landscape into Art, describes the theme as "....the beautiful subject of the enclosed garden, where Our Lady can sit on the ground and her Son play with the birds." At first the image of the Garden is very small, only a symbol of an enclosure. Later painters treated the Garden in art as an enlarged orchard, as in the descriptions of Boccaccio and Albertus Magnus. Nature in these images was treated symbolically, the white man being a creature of the Paradise Garden, separated from the Wilderness and not viewed as part of the unified systems of Nature. Jefferson and later De Tocqueville expanded this view to include the American land as a "garden", a wilderness to be shaped by hand and plow.

Frederick Jackson Turner in development of this theory of the American frontier identified yet another difference in the thinking of the red man and the white man, and opened new paths for growth of social conscience. According to Turner the white man was a "European Colonial" who chose to remain a foreigner in a strange and wilderness land; he did not accommodate himself to the land as the red man long before had learned to do. Robert Frost recognized this, too, and suggested the need for accommodation:

THE GIFT OUTRIGHT

The land was ours before we were the land's,
She was our land more than a hundred years
Before we were her people. She was ours
In Massachusetts, in Virginia,
But we were England's, still colonials,
Possessing what we still were unpossessed by,
Possessed by what we now no more possessed.
Something we were withholding made us weak
Until we found out that it was ourselves
We were withholding from our land of living,
And forthwith found salvation in surrender.
Such as we were we gave ourselves outright
(The deed of gift was many deeds of war)
To the land vaguely realizing westward,
But still unstoried, artless, unenhanced,
Such as she was, such as she would become.

Standing Bear also speaks to the distinction with equal eloquence:

> Indian faith sought the harmony of man with his surroundings, the other sought the dominance of surroundings. In sharing, in loving all and everything, one people naturally found a measure of the thing they sought; while, in fearing, the other found need of conquest. For one man the world was full of beauty; for the other, it was a place of sin and ugliness to be endured until he went to another world, there to become a creature of wings, half-man and half-bird....small wonder this man could not understand the other.

The distinctions became clearer as the westward migration reached the 98th meridian and settlers were confronted by the arid great plains. The American pioneer was an agriculturalist accustomed to the ample rainfall of the forests east. The plains were a land scarce in water, of extremes of heat and cold, of flat rolling surfaces where the winds blow constantly at high velocity, and where the sun shines brilliant and burning. It was the home of the Plains Indian with a culture adapted to this land over many generations. The Indian had acquired mastery over the horse before the white man arrived. The horse gave the Indian mobility and power both in the hunt and in battle. He was described rightly as the "Red Knight" of the plains. In confrontation the white man could at best get off three shots in a minute, two from single shot pistols and one from a rifle, whereas the red man, expert horseman that he was, could in that same time ride three hundred yards at top speed, hanging out of sight on his horse, and discharge twenty arrows. (From The Great Plains.)

As it was, late in the 19th century, the white man realized that the only way to dominate the Indian was to disrupt the plains ecosystem through destruction of the buffalo, his primary food source. As this was methodically accomplished, the white man first pushed on westward across the plains to the Pacific West, later to settle and control the plains themselves. The definitions of relationships to the land did not change. The white man merely displaced the red man and continued to dominate the land, remaining still a European in a strange and wilderness land.

D. H. Lawrence, the European, left no doubt that Americans were still Colonials, struggling to free themselves of European images, still struggling to find their "Spirit of Place" in the new land. In a letter to Gilbert Seldes in 1923, he spoke prophetically:

> But I feel about U. S. A. as I vaguely felt a long time ago: that there is a vast unreal intermediary thing intervening between the real thing which was Europe and the next real thing. Which will probably be America, but which isn't yet, at all.
>
> Seems to me a vast death happening must come first. But probably it is here, in America (I don't say U. S. A.) that the quick will keep alive and come through.

As we approach the Bicentennial year, that "vast death happening" may well be upon us in the form of the energy and environmental crisis, marking the end of our colonization of a continent that had been assumed to be of unlimited domain and resources. The white man at long last has come to realize that he, like the red man, is ultimately constrained by the limits of his environment, and to extend his kind into the future calls for redefinitions and redirection of cultural goals in America to make them compatible with the ecosystems of the land. Only then will the white man share with the red man a "Spirit of Place" in the

American landscape. This will not happen until each of us has followed Robert Frost and found "our salvation in surrender" to the land. Then as well, the white man will have developed a feeling for the American land that will support the "social conscience" that Turner called for at the turn of the century.

As with Jefferson, we must seek "....to utilize knowledge of the past to remedy present injustices and to help prepare for a better future."

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DISCUSSION

Question: I'd like to ask Mrs. Clusen how she would see the current political battle in overcoming such ideas as energy independence in the coming years. The current administration seems to completely ignore reality in this area. What is your experience with this? Politically, are these messages not getting through?

Clusen: It's a tough question. I wish I really knew. I do see it in a discouraging way, is the easiest thing to say, but that doesn't mean that we don't have to go on trying.

Why is the message not getting through? Because it is much easier and more comfortable for people to believe what they are being told, that we can and will become independent in 10 years. By the time the unhappy truth dawns on them, many of the incumbent officeholders who are pressing this point of view will probably not be around to reap the harvest of what they have sown.

I guess that I think one of the most effective weapons is going to be available in November. Question the candidates. Don't let them get away with simplistic answers and the kind of rhetoric which avoids the real issues. And of course, make them live up to what they've said they will do. Stay on their backs. Remember it when you go to the polls. It's the handiest tool I know of right now, and every incumbent is running scared this time, because nobody knows what's going to happen and what the reaction will be to the experiences we've just been through. Press the parties to make their candidates more responsible in regard to the statements they make about the energy crisis and the situation which we face. Challenge them when they encourage you to think that if you just turn down the thermostat two degrees and drive five miles an hour slower it will all go away. That's wishful thinking. But you know as well as I do that a lot of the American public likes to be told that the problems can be solved relatively easily and without much sacrifice. And I don't think the hard truths have dawned on most people yet. Tell your students, if you are a teacher, not to settle for this kind of response.

Ann Widditsch, the moderator for Session 1, is the planner-coordinator of the Symposium for the University of Washington.

Question: To both speakers. You have both addressed subjects other than science and technology in dealing with the environment and environmental education. Perhaps this isn't fair since it lies out of your field of interest, but do you see that science and technology will be the answer to all our environmental problems?

Barry: The power of science is neutral. The technology which results from science is also neutral. It will be used for those ends that we decide, and these decisions will reflect the value systems that we hold. And I spoke to some of the value systems that have been extant since the beginning of this country and of how they have interplayed with the American environment. I think it's extremely important that we not just depend upon science and technology with a simplistic hope that somehow or other the value questions will be dealt with adequately there. We cannot talk about science and technology in the contemporary scene when we're living with the value systems which were generated in the 19th and the 18th century in this country. They have to be brought into focus. And unless they're brought out and discussed in this sense, we will lack the holistic point of view.

I spoke of Jefferson. Jefferson was one of the early people that worked in American science, and he was effective. He produced new knowledge about the American environment, but he would not view himself as a scientist-technologist He was as concerned for philosophy as he was for anything else, and his Notes on the State of Virginia so reflects. So I would argue that we must have an interdisciplinary approach to this. And there are institutions that are doing this. For anybody that's interested, Lehigh University has a tremendous program, and bibliographic log of material, in the whole area of the humanities and technology. It's a new area. Since about 1900 we've narrowed things, we've specialized things down to the different disciplines so much that we have almost forgotten that the other areas exist; and suddenly now, with a confrontation about the environment as our previous speaker said (and I'm ready to endorse), we just can't deal with these problems through the approach of any one discipline.

Clusen: The main reason that I didn't talk about science and technology is that this is what most current environmental education is based on, and I was trying to indicate the other looks that need to be taken at environmental education. You know, Americans have been worshipping on the altar of science and technology for nearly the last century. I think there is no need to press this kind of framework because it's there, it's happening, and what we need is to add other dimensions to it. In no way would I put this down, because, as I indicated in talking about hearings and citizen action, we're helpless without the kind of scientific and technical information and background which scientist-technologists give us to back up the values we have chosen. But let us get away from the view that it can solve everything, and rapidly. It's only by moving beyond that framework, I think, that there is hope; but I do not mean to downplay the very important role which both play in maintaining some kind of effective environmental program.

Question: I was wondering if we could get the two speakers to comment on what they thought the value of the other one's perspective was? That is to say, Dr. Barry talked a lot about the needs in the early American period for Americans to escape from European images, to develop ones more appropriate to this country, and in many ways now we find ourselves in need of developing some new image of what a society might be like where we are more in tune with the world's ecosystem. And yet, listening to Ms. Clusen, the only perspective she has is crisis to crisis to crisis, when you're involved in a political fight to gain one thing or another in each--it's a very short-term thing without any image of the future. I'd like to hear each of you address whether the other's perspective is useful.

Clusen: I think we were approaching it in two different ways and both, I think, are equally valid. My ideas are a short term look. I tend to think in pragmatic, political terms. That's the nature of my job, and what I've been spending my time doing for the last 20 years. As far as environmental problems are concerned, the future is now. If we don't tend to our immediate crises and try to at least foresee the next one which is just over the horizon, there will be little time to think in deep philosophical terms about what will happen next, or where we're going.

But I think one of the most valid things that Dr. Barry said is that we must learn from history. He was saying, as far as I was concerned, that all of this is for naught if we haven't learned anything from past mistakes in the way we've handled the land, in our attitudes toward it. I did address myself to the immediate things which I think we can do here and now as educators and as concerned citizens to help us deal with our current problems because I'm afraid that there is not time right now to think that far ahead. But I don't think they're mutually exclusive. There's no reason that, in the course of tackling our present problems, we can't also be developing a different kind of image and philosophy about the environment. That should always be our ultimate goal.

Barry: I agree fully. There's no incompatibility; in fact, there's full compatibility here. Let me put it this way. If you attempt to meet the day-today decisions in a political framework without a perspective of where you as an individual have been and where you think circumstances ought to move, what are you doing? You're just rearranging matchsticks without any sense of purpose whatsoever. Thus I argue for the larger perspective.

At the same time, however, one does not dare stand on the hill and make preachments about goodness. One has to become involved. This is the responsibility of citizenship in a democracy. And you need perspective here, so you know why you're involved, and you're not just rearranging matchsticks. I would say, personally, that I think Project Independence is a very fine example of rearranging matchsticks without information and without the kind of philosophical perspective that the country really needs.

THE PRESENT STATE OF THE ART IN UNDERGRADUATE ENVIRONMENTAL STUDIES EDUCATION

James R. Albers

The history of undergraduate education in environmental studies is very short, with very few programs as much as five years old, and most four years old or less. This is too short a time to come to any final conclusions about the efficacy of these programs. So, today, I will confine my remarks to a description of the types of environmental programs that are now extant, some general comments and criticisms about environmental studies, and a few guesses about future possibilities for environmental studies. I recognize that there are exceptions to what I shall be saying. I have tried to give a general and consequently somewhat simplified overview of a cross-section of environmental programs.

There are presently many more programs in environmental studies than could be described in detail in 20 minutes. However, present programs seem to fall into two general groupings:

1) Programs that are characterized by none or a few faculty and courses of their own, whose courses and faculty reside in traditional departments and whose major role is one of coordination.
2) Self-contained programs where faculty and courses are primarily within the unit and which have considerable autonomy with respect to the wider institution.

The first type represents the most prevalent model for environmental studies programs at present. Although there are many variations within this overall classification, some examples of this type are the programs at Penn State, State University of New York at Buffalo, Dartmouth, and the University of Washington. It seems to be the structure primarily used at Universities. The advantage of this model is that it provides a focus and coordinating mechanism for all environmental classes and programs on a campus. There are, however, a

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Robert O. Sylvester was the moderator for Session 2.

number of disadvantages of this structure which have become apparent. From the administrative point of view there are often problems of territoriality. The success of the program depends on the cooperation and good-will of a large number of traditional departments and schools, and this is sometimes non-existent or even negative. This type of structure also often tends to impede rewards for the faculty member. Work done on environmental problems is not always recognized as appropriate disciplinary research and is not credited to tenure or promotion. This works as a disincentive for faculty to take part in environmental programs. A few schools, such as the University of Washington, have tried to alleviate this problem by working out the conditions of tenure and promotion with each department before joint appointments are made. From the students' viewpoint the program often lacks cohesion and course materials are not always well integrated since courses are taken in different departments.

Some examples of programs of the second type are those of the College of the Atlantic, Kresge College and Huxley College. These programs are all housed in separate colleges. The College of the Atlantic is totally devoted to environmental studies. Kresge College is part of the University of California at Santa Cruz and Huxley is part of WWSC. The advantages of this administrative arrangement for the faculty is that the criteria for tenure and promotion rest with the environmental studies unit and not with other departments. This means that community service which is an important part of most environmental programs may receive as much weight as research activity for purposes of tenure and promotion. From the students' viewpoint, the single unit has the advantage of providing a sense of community--a belonging to an identifiable group. Separate units make it easier to provide students with extracurricular activities and social events which help build a feeling of community. Probably the greatest advantage of a separate college or school for environmental studies is curricular autonomy. The ability to explore new curricular configurations is especially important to environmental programs where there are no traditional curricular guidelines. As Clark Kerr has said, "Changing the curriculum at a University is like trying to move a cemetery." Programs that can make curricular changes without going through the whole university curricular mechanism have a much better chance to be innovative and flexible. As usual, there is a price one pays for this advantage. It usually takes the form of the dual charge of "watered-down courses" and "course duplication". I would like to defer the question of academic quality for a few minutes. The problem of course duplication has several aspects. Occasionally there may really be duplication, e.g., a course in ecology taught by the biology department and in the environmental studies unit. Any such real duplication should, of course, be eliminated. The problem arises when both units teach a course such as ecology with the same title and different content, or even with same or similar content, but with different viewpoint and emphasis.

Often no one checks on the details and there are charges and countercharges of duplication and wasting of resources which result in increased hostility toward the environmental studies unit.

Another disadvantage of the separate unit is that it may become isolated from the other programs on campus. A feeling of siege sets in and it becomes "us against them". This makes the environmental studies unit especially vulnerable when resource allocations are made. This is particularly true at present when resources are scarce and many institutions have experienced budget cuts. Environmental studies is the new boy in town and represents a target of opportunity for the older established programs.

Some independent environmental programs have also experimented with alternate grade structures and other educational innovations which have made them appear radical in the eyes of the more traditional groups on campus. This tends to reduce on-campus communication and increase the isolation of the program.

In summary, coordinating units have better communication and fewer problems with duplication but tend to have problems with faculty rewards, cohesion and curricular autonomy. Separate programs tend to have just the opposite situation. They have problems with communication and duplication, but usually are cohesive, have curricular autonomy and a satisfactory faculty reward system. I don't think there is any easy answer to the question of which of these structures is the best. It depends too much upon the particular circumstances, traditions and political ambience of each institution. It is important that people who are planning new programs be aware of the advantages and disadvantages of each structure, but a final evaluation can only be done in terms of the specific conditions on their own campus.

More important than the structure of a program is its content. The content of environmental programs is as diverse as the environment itself. They range from very qualitative, descriptive courses to very sophisticated mathematical modeling and analysis courses including environmental sciences, human ecology, environmental education and many others. I see no point in just cataloging the various course offerings that have been proffered under the aegis of the environmental studies banner. I would, however, like to point out a few fairly common aspects that have tended to make environmental programs somewhat different from the majority of the more traditional areas.

First, most programs have an introductory or core course. This, of course, is not new and these courses suffer from the same defects as other introductory courses, i.e., heterogeneous student background, shallowness of coverage and so on. I think, though, that there are some differences worth noting. The problem of variations in background is probably even worse than in other areas due to wide variations in high school preparation. Some high schools are doing a good job on environmental studies and a few students have an excellent background. Others have essentially no programs and the only background they have is what they've read in newspapers. Hopefully, this situation will improve as the high schools develop their programs. However, until they do, the core course is liable to generate considerable student discontent because one group is bored to death and another is in over their heads. There are ways to remedy this problem: credit by examination and waivers for the well-prepared student; special sections for the poorly prepared student. It is a problem that instructors need to deal with very carefully.

There is a second and more important way in which many environmental core courses differ from other introductory courses. This is in the effort to present not only a wide range of information, but also some sort of integrative structure within which that information can be organized into a coherent view of the environment. I think it is the emphasis on this holistic perception that really distinguishes the environmental approach. The environment is a very complex system with multiple, subtle interconnections and feedbacks. It is the realization that the connections are as important as the things they connect which is the strength of the environmental curriculum and particularly of the environmental core course.

Another pedagogical emphasis which distinguishes environmental studies from some of the more traditional programs is the emphasis on some practical involvement of the student with the off-campus world. This idea takes many forms in different programs. It can be an internship, a work-study program, membership in environmental action groups, recycling centers, student projects or even classwork, and I am sure there are other modes of which I am not aware. Whatever the mode, the purpose of these experiences is to give the student an opportunity to apply what he has learned in a real world situation, with all its difficulties and frustrations. In addition, these programs seem to be very popular with students.

The final and, I think, most fundamental difference between environmental studies courses and more traditional courses is the emphasis on a problem-centered, holistic approach rather than a fact-centered approach to curricular organization and content. For example, an environmental problem such as air pollution is considered not just as a technical problem, but also as an economic, social and political problem. Although this method is embraced in the written descriptions of most environmental programs, my impression is that it is sometimes more rhetoric than fact. This is not hard to understand if you have ever tried to teach a problem-centered course. It requires considerable rethinking of pedagogical strategies and a lot of preparation time, particularly when including information from outside your area of expertise. These pressures make it easy to slip back into old habits with the resulting beast being neither fish nor fowl and with the result that no one is very satisfied.

Indeed, it may not be desirable that every course have this format. However, the advantage of this technique is that it emphasizes the whole system and the interactions rather than a specific part of the system, which is a treatment which is more congruent with the actual nature of environmental problems. I hope we can continue to expend the effort it will take to refine and expand this teaching technique.

In summary, I see three factors which tend to differentiate the majority of environmental programs from traditional disciplines. They are the integrative nature of the introductory course, the emphasis on some sort of practical experience, and the use of problem-centered courses.

Next I would like to consider some criticisms which are often leveled at environmental studies programs from the outside and then some problems that I see from the inside. Probably the most common criticism from other academics is a concern over the quality of environmental programs. This takes the form of charges of watered-down courses or that students know a little bit about a lot of things but have no depth in anything. I am sure that there are indeed poor environmental courses just as there are poor courses in other areas. There are perhaps even more such ones in environmental programs due to their newness, but there is an underlying problem which is I think based to some extent on a misunderstanding regarding the purpose of many environmental courses. This misunderstanding occurs because the purpose of the course is not to increase the sophistication of the information presented, which is often the goal in other areas, but to discover new arrangements and relationships among that information. This concern with a holistic, systems approach to knowledge is often misconstrued to be lack of rigor. The only solution to this problem seems to be more effort on our part in explaining to our colleagues what we are trying to do in these courses.

The second question of the generalist vs. the specialist may never be satisfactorily resolved. There is a need for both types of people--those who can take ideas apart as well as those who can put them back together. I think there is also a compromise. If the generalist is a mile wide and an inch deep and the specialist an inch wide and a mile deep, perhaps we should be turning out students who are funnel-shaped--who have a broad environmental background, but also with some expertise in one area. Obviously, it takes time to give a broad background--time which, therefore, is not available for specialized study. Thus environmental students with an interest in chemistry won't know as much about chemistry as a chemistry major, but their training should be sufficient to enable them to do the practical chemistry of pollution monitoring. Such a person could hopefully avoid the pitfalls of both over-specialization and shallow generalization.

The next comments I would like to make grow out of some of my own observations of the process of environmental education. There is a lot of casting about for directions and some schizophrenia in environmental programs. An example of the latter is those who want their environmental program to include a large amount of eco-action: active resistance to local polluters, attempts to influence legislation, and a general identification with environmental causes. Opposed to this is the idea of the honest information broker: an unbiased, expert source of information about the environment. This person sees his credibility being destroyed by espousing particular causes. This schism occurs not only in programs, but also in individuals. I don't think that professionally we can have it both ways for very long. This does not mean that we should discourage our students from eco-action or that as individual citizens we shouldn't participate in various environmental causes. However, if we are going to establish ourselves as credible, professional environmentalists, we cannot uncritically support every environmental issue that comes along. Nowadays most environmental decisions involve some sort of citizen participation. The problem, it seems to me, is that citizens almost never have a source of unbiased technical information to guide them. Very often they are called upon to make sophisticated decisions from food additives to nuclear energy with little more than propaganda to aid them. I hope that as professionals we can contribute to the quality of public debate by providing reliable information on environmental questions.

Another division which occurs in some environmental programs is environmental science vs. environmental studies. This is often accompanied by the implication that the former is rigorous while the latter is a little soft-headed. This is partly a reflection of old attitudes and has its roots in the two cultures problem. I think, though, that if we are committed to a holistic view of the environment, human ecology, environmental education and planning are just as necessary to understand the environment as environmental science. This is not to argue that every program should have all of these elements, but that it is necessary to understand the role of science in the wider social setting and that there is hardly any environmental problem which does not have social and political implications.

The final comment I would like to make concerns the conflict between advocacy and open inquiry. To illustrate what I mean I would like to read two short quotes from the catalogue material of two different environmental programs.

> All of this might be termed an out-reach program of community education to incuicate the proper value system regarding economic development versus the preservation and proper management of the natural environment and to study actual cases leading toward community action plans to solve the problem.

> It is the identification, analysis, discussion, planning and action on these key problems that together with the inculcation of the proper value system will lead to the protection, preservation and proper management and use of the natural environment.
>
> Our courses study the world as a system of organized structure, and the courses themselves make up a coherent and interdependent system. We do not neglect the practice of what we teach, and much of our attention is given to ways of effecting practical change in the world once we have discovered what these changes should be and what effects they will have. (emphasis added.)

These comments betray the true believer. The idea that environmentalists know how the world should be changed or what the "proper value system" is is both pretentious and dangerous. History overflows with examples of the harm that such arrogance can generate, from Roman emperors to religious zealots. This demand for doctrinal purity is understandable in an occasionally beleaguered minority, but it is inexcusable in an academic enterprise. This does not mean that we should not examine personal or social values, but that value systems should be examined with the same critical analysis as other concepts. I find this issue to be the most serious of all the criticisms of environmental programs. I hope that this aspect of environmental studies will disappear as our programs become more mature, and that we shall be able to approach environmental studies with the same sense of open inquiry that we would in other academic areas.

Finally, I would like to indicate a few future trends in environmental education. I am well aware of the problems of predicting the future whether one uses the entrails of birds or computers, so these remarks are offered with suitable trepidation. As I mentioned at the beginning, environmental studies is very young and has had growing pains, some of which I have already discussed, and it will doubtless have more. However, the problems of the environment are so critical and the need for people who can deal with them so severe that it seems to me there is no chance that such programs will disappear. In fact, my perception is that environmental programs are becoming more intellectually demanding and that we are moving toward the establishment of a new discipline, i.e., a new branch of knowledge which combines parts of many older disciplines in the same way that biochemistry combines parts of the older disciplines of biology and chemistry. This will mean new graduate schools and Ph.D.'s in environmental science and environmental studies and the whole educational apparatus that goes with them in our society. Our present programs will undoubtedly mutate, but I hope that what I think is the greatest strength of environmental studies remains--namely, the systems or integrated approach to problem solving. Further, we might consider as a goal for undergraduate environmental education the development of people who are trained in the art of the utilization of knowledge to meet human needs.

GRADUATE EDUCATION AND ENVIRONMENTAL STUDIES

Russell F. Christman

An analysis of the status and needs of graduate environmental education is a difficult task. Without sinking into the academic habit of rigorous definition it must be recognized that what is meant by the term "graduate environmental education" depends very heavily upon the background of the analyst. Partly this is due to differences in what is meant by "environmental" studies and partly it is due to different interpretations of what a graduate school experience should be. I want to emphasize that these differences of opinion are responsible for what might best be called an unbalanced approach that universities have made to environmental study at the graduate level. Further, it is my belief that more effective university response must await systemic changes in university structure which might result from a lessening of the science/humanism polarity that exists on campuses today.

As an example of the first difficulty, "environment" is used by some to describe surroundings and in this sense it is a directional concept, describing a defined area around a person or an object. In another sense it is used to identify a problem category analogous to urban decay, traffic accidents, poverty and hunger. In its most esoteric usage it is a philosophical extension of ecological principles through which human activity can be judged according to conformance with known natural forces. None of the most common usages is completely inscribed by any traditional body of knowledge at least as represented by university departments (1). We are therefore not speaking of a body of knowledge with regard to environmental studies but a deep-rooted social problem to which bodies of knowledge may be applied. The second difficulty arises through comparison of traditional graduate programs which are based upon extensive undergraduate preparation in a specialty field (e.g., zoology, economics, microbiology and chemistry) and those in which the first real exposure to the specialty occurs at the master's degree level (e.g., environmental engineering). In the former case the graduate experience is devoted to extending skills developed earlier, getting a firm grasp on all major elements of the body of knowledge and through

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research training working one's way up to the frontier of knowledge in the area. Unfortunately, traditional departments at universities tend to exclude practical applications from their curricula. Universities, in particular, tend to regard their duty as one of adding to, polishing, admiring or rearranging the body of knowledge, but not of using it to solve problems. In the latter case where departments (often engineering) are oriented toward problem solving, a significant portion of the graduate experience must be given to remedying certain "undergraduate deficiencies" and to the extent this is true, time is lost for other graduate purposes. This problem is characteristic of all graduate efforts which do not build upon sound undergraduate preparation and constitutes the most significant obstacle to high-quality research in these programs. I will return to this problem after comparing what is being offered at the graduate level today with a framework for environmental research questions typical of graduate study.

CURRENT GRADUATE PROGRAMS

There has been a tremendous increase in the number of environmental offerings (courses, programs) at universities since the mid 1960's. Almost every university has a general Man and His Environment offering but other courses on Environmental Law, Environmental Resource Economics, Environmental Chemistry, Environmental Engineering, Environmental Planning can be found at the graduate level. Most of these courses however and most of the M.S. and Ph.D. degree programs that are available are in the technical fields of science, engineering, urban planning, or special professional schools such as Forest Resources and Public Affairs. These programs number in the hundreds (Table 1) although there is virtually no standardization of content among them. A much smaller number of graduate-level Institutes for Environmental Studies have developed on some campuses and are generally oriented around special interdisciplinary research studies usually in close association with sponsoring departments; in most cases they are dependent on these departments. Although the data regarding the exact number and content of existing graduate environmental programs is sparse, several generalizations can be made. First, programs in the social sciences and humanities are very few and their input into existing technical programs is slight. Second, although technology has often been cited as the cause of environmental problems, graduate technical programs have been by far the most responsive to environmental educational needs. Among the technical fields, Engineering, particularly Civil Engineering, has the longest history of educational concern for environmental studies (Table 2).

TABLE 1

Program Categories Related to Environmental Studies
and Listed in the 1974 Annual Guides to Graduate Study
Published by Peterson's Guides, Inc., Princeton, N. J.

Title of Administrative Unit	Number of Programs Listed
Divisions of Biological Sciences (including medical school departments)	104
Departments of Biology	295
Programs and Departments in Ecology	46
Programs and Departments in Environmental Biology	20
Programs and Departments in Virology	31
Departments of Zoology	105
Agricultural Engineering	101
Bioengineering	108
Biomedical Engineering	11
Chemical Engineering	138
Civil Engineering	148
Environmental Engineering	48
Sanitary Engineering	21
Environmental Health Sciences	44

Assembled by Mrs. Jan Miller, Environmental Sciences and Engineering Department, The University of North Carolina at Chapel Hill.

TABLE 2

Environmental (Sanitary) Engineering Education (USA)

First Formal Instruction	- M.I.T. (Sedgwick)	- 1890
First Graduate Program	- Harvard (Whipple)	- 1911
First Doctorate	- Harvard (H. G. Baity)	- 1927

Civil Engineering has housed the subspecialty Sanitary Engineering for over 60 years. Sanitary Engineering has been relabelled Environmental Engineering within the last 10 years. In the late 1950's Sanitary Engineering programs "interdisciplinized" before this act was virtuous by adding biologists and chemists to their engineering faculty. These programs are the strongest, most numerous and best organized of the graduate technical environmental programs today, and currently have all the trademarks of an independent, identifiable professional discipline, i.e., they maintain a national professional society (Association of Environmental Engineering Professors), support an accreditation mechanism, specialty research journals, and have recently recommended the developmemt of undergraduate programs. (2) The Association of Environmental Engineering Professors Register of Graduate Programs lists 71 separate M.S. and Ph.D. curricula at different institutions (3). A measure of their strength and identity can be obtained from the fact that in the ten-year period from 1962-1972 The Environmental Protection Agency and its predecessor agencies invested over 25 million dollars in water quality training grants to approximately 100 different universities to support the preparation of over 4000 M.S. and Ph.D. graduates trained to cope with water pollution problems (4). During this same period a smaller number of grants were awarded these programs for the training of air pollution, radiological hygiene and solid waste specialists, and federal investment in research grants in these programs has exceeded the training grant investment by several times. Ironically at a time when current legislation will require 8000 new positions in air pollution control and 20,000 new positions in water pollution control by 1976, the federal government is terminating its environmental training grant program (5).

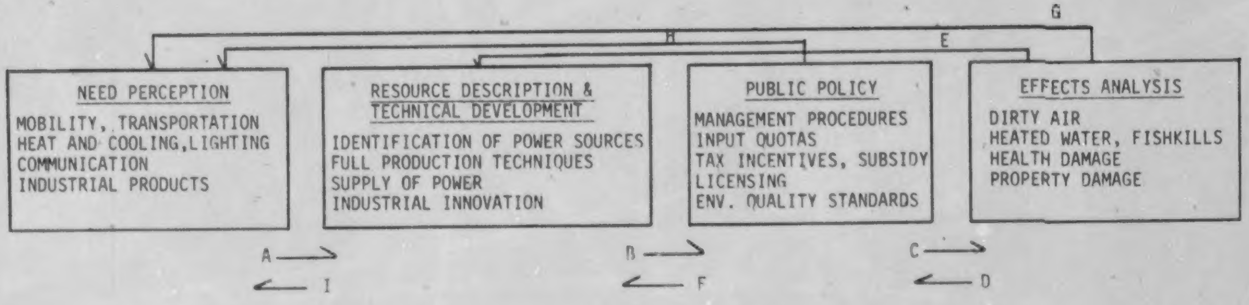
development of some material section of nature which will satisfy the need. If significant material or economic quantities are involved public policy will be formulated to regulate the development and the resultant effects on the environment will in time be observed (Figure 1). This framework is of course arbitrary but it serves to emphasize the point that the areas of intensive need for new research and the interrelationships between these study areas are well known to us (Table 3), and are fully addressable by current academic divisions of universities. Technologists are facing these questions every day but find they are not properly equipped to deal with them in the key areas of Need Perception, Public Policy and the non-physical parts of Effects Analysis.

TABLE 3

Components of Environmental Studies (8)

Need Perception	Studies of human motivation, goal and value discrimination as a function of culture, personality and experience, focused on human values for space, food, shelter, mobility, etc.
Resource Description & Technical Development	Studies of the quantity, quality and characteristics of any material useful to man; the oceans, forests, atmospheric resources, etc., and devices used to extract, convert or use these resources.
Public Policy	Studies of the institutional characteristics, governmental and agency strategies for implementation or regulation of actions affecting use of resources.
Effects Analysis	Studies of the impact on resources of users of these resources resulting from activities undertaken to satisfy perceived needs. Development of environmental quality indicators.

Social scientists and humanists have not joined the inquiry to a significant degree due to the fact that universities have made an incomplete adaption to the addition of technological specialization to the list of university functions. Actually, universities are still struggling with the union of science and humanism and with its modern day counterpart, liberal versus specialist education. Academic governance through departmentalization of faculties helps preserve the idea of a university but is an obstacle to adaptation as it separates


G
H
E
NEED PERCEPTION
MOBILITY, TRANSPORTATION
HEAT AND COOLING,LIGHTING
COMMUNICATION
INDUSTRIAL PRODUCTS
RESOURCE DESCRIPTION & TECHNICAL DEVELOPMENT
IDENTIFICATION OF POWER SOURCES
FULL PRODUCTION TECHNIQUES
SUPPLY OF POWER
INDUSTRIAL INNOVATION
PUBLIC POLICY
MANAGEMENT PROCEDURES
INPUT QUOTAS
TAX INCENTIVES, SUBSIDY
LICENSING
ENV. QUALITY STANDARDS
EFFECTS ANALYSIS
DIRTY AIR
HEATED WATER, FISHKILLS
HEALTH DAMAGE
PROPERTY DAMAGE
A
I
B
F
C
D

Direct Research Questions

A. Given a desire for power, what section of the material universe constitutes a power resource (fossil fuel, nuclear fuel, water, etc.)?

B. Given that a certain type of fuel (nuclear) is desirable for use in power production, what type of management procedure (AEC policies) should be implemented to regulate its use?

C. What effect will the level of nuclear power development as anticipated by AEC have on man and his physical and mental environment?

Feedback Research Questions

D & G Both loops represent threshold phenomena. Threshold levels of effect are functions of the sensitivity and accuracy of environmental quality indicators and communications procedures.

Example of Loop D. How can feedback time between observed effect (temperature or radiation levels) and policy adjustment be minimized?

FIGURE 1

Framework of Environmental Studies Questions (8)

Example of Loop G. In cases of large effect levels which cannot be reduced by ordinary policy decisions, the perception of need for power must be re-evaluated.

E. Does a 10^0 rise in river water temperature constitute a new source of low-grade thermal power? Are new resources created as a result of effects?

F. Does the grant funding policy of a major regulatory agency affect our level of understanding of the quality and quantity of material resources?

H. Does advertisement by a power producer affect our perception of need for power? Does regulation of information on radiation levels by AEC affect our perception of benefits of nuclear power?

I. Does new technological development (nuclear fusion) affect our perception of need for power?

FIGURE 1 (con't)

Framework of Environmental Studies Questions (8)

NEEDS IN GRADUATE ENVIRONMENTAL EDUCATION

The question remains as to where these developing technical programs fit in the nation's need for graduate environmental education. I would suggest that the emergence of Environmental Engineering is an ordinary and desirable evolution within the engineering educational sector as these programs are struggling to produce the very technologists society needs to conceive, plan, design and implement environmental quality control devices. It is not however the answer to the nation's environmental problem. In the first place, engineers deal with the results of the problem--not the cause. In the second place, by stimulating the demand for large-scale central treatment facilities in urban areas they may even have aggravated the problem of land development and urban sprawl. Technologists, however, do not tend to overstate their role in meeting national needs. Their sense of purpose has always been keyed to manpower needs and their enrollments have traditionally fluctuated with trends in the national job market.

It is a common illusion among newcomers to the environmental studies field that an innovative and interdisciplinary degree program if established could provide graduates capable to solving the nation's environmental problem. Typical of these suggestions is that of Dr. Willard Libby at UCLA which calls for a new degree program to produce an "Environmental Doctor" (7). The function of this product, much like his medical analogue, would be to diagnose the effects of proposed actions and advise decision makers of environmental consequences before steps are taken. The proposal calls for these graduates to be "trained in all aspects of physical and ecological science and engineering," and they would leave graduate school with the equivalent of undergraduate majors in three of the areas--mathematics, physics, chemistry, biology, engineering and earth sciences. This suggestion implies not only a complete devotion of graduate school time to remedial studies but more fundamentally it denies the very nature of the environmental problem. We do not need a new kind of person with a sign around his neck announcing that he or she is here to solve our problem; we need the same kinds of products we have now, chemists, engineers, business managers, economists, school teachers, etc. but with their senses of values altered. To the extent that such a new product would find a place in the decision-making chain it would be counterproductive to reducing our individual demand for resources which is of course the problem. Through the environmental impact statement process and through public hearings, administrators and average citizens are already struggling with priorities and values at the local level. A professional advice giver is the last thing needed.

At this point it might be instructive to look at the conceptual framework in which environmental research questions appear. All actions affecting environment can be viewed as arising from the perception of need proceeding through the engineer from the chemist and the chemist from the historian. Unlike pure science, technology is inseparable from humanism and as Lord Ashby (6) has so appropriately noted, "the technologist is up to his neck in human problems whether he likes it or not." It could be that technological problem study, such as environmental study, could become the cement between science and humanism.

This will require expansion of the humanistic content in technical studies and an equivalent expansion of technical offerings in liberal studies. One of the principal problems of graduate environmental education, the need for increased contact between different parts of the university, cannot be separated from changes in the undergraduate curricula.

Technologists need to develop undergraduate programs within the specialty areas to permit a more effective use of the graduate-level experience. Secondly, they need to participate in the development of new courses designed to acquaint the non-technologist with the major technical problems faced by society. Thirdly, they need to build relevant humanistic studies into their technical specialists. This will require more than extending the humanities/social science requirement for undergraduate engineers, since carefully constructed courses are needed through which young technologists can be shown the deep social effects of technological change.

These changes are substantive and involve changes in personal values just as the environmental issue demands. It was a long time before liberal curricula at universities contained a science component and we might expect a similar time lag prior to incorportion of technological appreciation into these programs. The key is simply this, to recognize the overriding need for the development of a technological humanism--a coalition of currently separate intellectual communities on our university campuses; not to mass produce a patched-together environmental adviser.

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FINDING A NICHE IN ENVIRONMENTAL EDUCATION: THE STUDENT'S STRUGGLE TO SURVIVE*

Nancy Jane Stockholm

INTRODUCTION

Surviving many features of American education is a struggle in itself, but most undergraduates interested in environmental studies face more than their share of struggles in planning and implementing their education. During this symposium, experts will address specialized issues in environmental education. I appreciate this opportunity to offer my views from an undergraduate's perspective. In this paper I define "environmental studies" broadly to mean course offerings and programs that contribute to the education of the generalist or the specialist in the environmental field.

Although I illustrate points about environmental studies with a number of personal examples, since high school I have known many other students with similar interests who have shared my problems. During two years of college in the East, and now as a transfer student at Stanford, I have worked with departments and curriculum committees as well as individual faculty and administrators--both sympathetic and unsympathetic to those problems. I also served on the Task Force of the Superintendent of Public Instruction to develop a master plan for environmental education in Illinois. I hope that these experiences have broadened my appreciation of administrative and educational problems, but certainly I speak primarily from a student's viewpoint. My paper examines several areas of concern to me: advising on a high school and college level, college frameworks for environmental studies, the role of the faculty, process education and internships, and government support for undergraduates. If I seem critical about environmental education today, this is not to ignore many fine programs going on now, but to emphasize their rarity, especially on the undergraduate level. Also, I feel that I have been more fortunate than many students regarding opportunities for environmental studies. As I relate personal examples of my problems, remember that I came from a high school with an outstanding environmental orientation, that my secondary school's high rating helped me get into an "elite" college, and that I could afford to transfer when I felt that Stanford provided more environmental offerings.

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*I appreciate the assistance of Prof. Leonard Ortolano of Stanford's Civil Engineering Department in preparing this paper.

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THE HIGH SCHOOL STUDENT'S BACKGROUND

In many ways, I had more chances for environmental studies during high school, than during my first two years of college. Obviously, I am not advocating a concentration in so-called "environmental courses" in high school or college. I am referring to experiences inside and outside the classroom that increase students' awareness and motivation. Along with hundreds of high school students I attended intensive week-long workshops on conservation at Southern Illinois University. Students like me returned to their high schools to organize new courses like environmental biology or to set up clearinghouses for environmental projects and information in the community. The success of these programs depended on the willingness of teachers and administrators to recognize and channel student enthusiasm. I'm sure that other speakers will describe in detail the ability of students like those at Oak Park-River Forest High or with the Cleveland Institute for Environmental Education who are, among other projects, lobbying in their state capitals, writing local legislation, and gathering scientific data acceptable in court cases.

ADVISING--HIGH SCHOOL

Encouraged by imaginative environmental studies and process education in high schools, students like myself face their first problem when they try to pursue these interests. Students of widely different backgrounds and capabilities have practically no way of getting information about colleges or vocational programs. Most high school counselors have no training that would enable them to advise these students about a job or college. Students still hear what I heard from some counselors: "You want to major in environmental studies? Why, to be a forest ranger?" College representatives are usually vague regarding their school's environmental programs. Alternate sources of information like teachers and even people now employed in environmental positions are not always helpful, because the field is so new that they often have had no formal training for their positions.

STUDENT NEEDS

Advising needs to inform three basic types of students:

1) The relatively few who know that they want a specialized environmental career like environmental engineering; or a job like a park employee or wastewater technician, not requiring college.
2) Those seeking a broad, but cohesive interdisciplinary program to prepare them for law school, business school, journalism, or other graduate study.
3) Those who consider environmental studies important to their liberal education.

Ideally, all students should be exposed in a multi-disciplinary way to environmental considerations, but these three groups represent students who choose schools according to environmental offerings. These are also the students most handicapped by poor advising and limited educational options throughout college.

I know of no government publications that describe environmental careers and study options for high school and college students. Therefore I looked forward eagerly to the Environmental Protection Agency's (EPA) new environmental career booklet. This publication does make a start, but it is a slow start! The booklet briefly describes some blue collar and white collar environmental jobs, and then suggests that students go to school counselors, "a good source for further information on general and specific subjects." Then it goes on to recommend that students write to state and federal agencies for more information.

As I said before, many counselors in high schoo don't have the material students need, and the state and federal agencies that I am familiar with can't handle volumes of requests, unless the agencies simply send a general pamphlet out. A department head in the National Park Service told me recently that he receives thousands of letters from students each year asking for career and college information, many of these inquiries prompted by high school counselors.

Descriptions of schools and jobs must be more comprehensive than those in the EPA booklet. For example, a student in high school using the publication would find a two-line description of some colleges and universities--in code form. The code indicates (if the information is available, which it isn't in many entries) whether there is an A.B., B.A., or B.S. degree, or Ph.D. program existing at the school in some way connected to the environmental field. The entry may also give a number for how many courses are available there in an environmental area (an essentially meaningless number). The most useful part of the EPA guide is the last page that lists addresses for career information. If a student writes to the Conservation Education Association, he may obtain their college directory which includes a paragraph or more detailing options at many schools, as well as the names and addresses of college department chairmen to write for specific details. Also helpful is a list of colleges from the Student Conservation Association, which gives average tuition costs for schools along with information on environmental programs.

COLLEGE FRAMEWORKS

Educational information is important not only to high school students who are selecting a college or job, but to college freshmen.

Although they might not have to select a major until sophomore or junior year, entering college students usually must select a department, and choose between a B.A. or B.S. program. College catalogs in general do not give a clear idea to new students of what options are available. Too many students, myself included, have been lured fresh out of high school into natural resources departments in large universities, where they are channeled into a narrow curriculum still designed for wildlife scientists and outdoor recreation specialists. In my case, I was attracted by an "environmental conservation" major at my school, only to discover after a disappointing first year that my courses were the same as a fisheries or wildlife student's, except that I had a few more electives, most of which had to be chosen from the department or at least from the School of Agriculture. What especially disturbs me is that the department's literature and orientation actually discourages students about opportunities in the very fields it trains them for. Under "aquatic science" the university notes, "even for those with advanced degrees, appropriate jobs are not plentiful at the present time." Under "fishery science" the school warns, "much interest in this area of study has increased competition for both jobs and graduate study." The department makes no effort to suggest alternative studies related to the environment, and ones that have substantial assurance of providing future jobs.

I entered the natural resources department, because I thought it came closest to my interests. I had no idea, even after I spoke with my freshman advisor, that I could have designed an independent major in the College of Arts and Sciences combining courses from natural resources, economics, political science, and other departments.

But natural resources departments are not the only narrowly-designed college departments. The School of Engineering at my first college is an example. Although Engineering offered some courses on pollution and the environment, and some limited environmental specializations, the curriculum was so structured that engineers couldn't take courses from the natural resources department, or even many from political science, and the humanities in general. I attended some of the engineering courses that the department offered, and found that these courses were biased with little or no consideration given to ethical and social aspects of technology and the environment. I also took two sequential courses on the environment from the natural resources department for three hours in the fall and for two hours in the spring. Engineers in my class told me that although they had learned much from the fall term, they couldn't take the spring term because they needed a three-hour elective. An arrangement to give engineers an extra hour of credit for research on environmental engineering or something related was not an option--there were no faculty to speak of in engineering that would supervise the study for credit, and the smaller natural resources faculty was overworked already.

MAKING FRAMEWORKS FLEXIBLE

At this point I would like to describe two examples that show how traditional departments can adapt to environmental education.

Recently I spoke with Dr. Loren Cole, principal organizer of Berkeley's Department of Natural Resources. This program, "Conservation of Natural Resources," began in 1970 after two years of active planning. Begun with sixty students, it now has three hundred (with many turned away), and has involved eight hundred faculty from sixty departments. Students can apply directly to the Department, or from other parts of the university. There are three core courses, the first one being for freshmen. This course puts new students together with faculty members in small groups in an outdoor setting. Together they discuss educational goals and the practical problems of designing individual programs.

The faculty associated with the department encompass a wide range of backgrounds. Soon after students enter, they submit a paper stating their purpose in being in the department (specific or not). Each student receives a dossier on faculty members, and several recommendations for advisors. Students then interview several advisors and choose the one they want. Also the students can switch advisors anytime, which is not too practical at many institutions. The administrative affairs and hiring/firing are the responsibility of an elected committee, half students, half faculty members.

As to the quality of such an unstructured program, a few examples will testify. Twelve National Science Foundation grants have been won by students in the last three years for independent research, as well as grants from the state and companies like Dupont. The students' research is on a range of issues from teaching environmental education to urban children to writing environmental laws.

Almost no student project is too ambitious in the eyes of the faculty, who instituted the unique concept of "Fail and Get an A." This means a student can tackle a project that he later realizes is too difficult or broad, but he can learn by trying and then summarizing his mistakes (and still get an A). Often such a "failure" encourages the student to take additional courses to cope with the problem. (Suddenly there's a reason to take environmental health and chemistry, if you're researching air pollution.)

Internships and field work are integral parts of Berkeley's program; students can get eight to fifteen credits for an "academically relevant" project. An example might be setting up a complete water quality monitoring system for Monterey Bay, or drafting a flood control plan for a state agency. The point here is that "academically relevant" does not mean traditional in the educational sense--it means challenging and educational for the individual student.

The students do receive excellent preparation for careers; 95% of the graduates are employed in jobs related to their education, and the demand for students graduated from Berkeley's program is increasing. I would add that another important indicator of success is the enthusiasm of both faculty and students for a program in which teaching is emphasized, and where students come first as individuals. Educationally, I think that Berkeley's program recognizes the flexibility necessary to prepare an environmental decisionmaker. Says Dr. Cole, "We realize that an ecologist can have the right knowledge, but the wrong conceptual framework."

Although I am new to Stanford, I have noticed a different approach in the Engineering School here, as compared to my old college. Stanford's Engineering School has a technical program that still permits innovative concentrations in environmental studies. Along with a rigorous scientific background, the department requires that students "have an appreciation of the role of technology in society". At least two courses addressing the engineer's role in society are mandatory, and in addition students usually have thirty to forty units of electives. In order to help students design individual majors, the School makes available lists of course plans and advisors for bio- or premedical engineering, urban planning, ocean engineering, and engineering and society. Graduate programs include environmental planning, urban and regional planning, environmental radioactivity, and engineering-economic planning: programs which draw on other courses in the university from political science, economics, values, science and technology (VTS), communications, computer science, sociology, statistics and food research. Other unusual majors besides those listed are available with the approval of a student/faculty committee.

The important characteristic of both Berkeley's and Stanford's programs is that they not only provide students with curriculum flexibility, but they make information readily available to them.

INTERDISCIPLINARY STUDIES

My sophomore year in college, I decided to transfer from Natural Resources to the College of Arts and Sciences, where I thought I could design an independent major tailored to my interests. It was a great idea--little did I know that I would spend an entire semester running from department to department to obtain advice on courses. I was expected to submit a four year plan listing numbered courses, and to follow that plan, unless I submitted another statement signed by my advisor explaining any course changes.

My advisor, who was in the Government department, helped me select government courses, but it was my assignment to interview professors and students from departments in engineering, architecture, economics, natural resources, agricultural economics, industrial and labor relations, English, education, biology, chemistry, botany, sociology, and from the law and business schools. I had no curriculum plans to follow, and no help from the committee that reviewed my proposal, except a caution not to "plan a cafeteria-style major." I do feel that a student should have the responsibility for his education and the initiative to work for that education, but I and many other students I knew had a difficult time determining which courses to take and in what proportion. Just the time to organize my proposal took significant time away from my classes.

It is wasteful at a school with so many course offerings not to have an interdisciplinary committee to advise environmental studies students. A university-wide curriculum committee at the university was formed two years earlier to make recommendations on interdisciplinary studies relating to the environment. Unfortunately during my time there the committee produced nothing helpful for students. Other students and I, along with a faculty member, were told by committee members that meetings were closed to students, and that student representation would be appropriate only in later stages of the committee's work. After a year of persistence, another student and I were invited tentatively to a meeting of the committee last summer on campus. When I wrote to indicate that I would be glad to drive from Chicago to attend, I never received a reply with the exact date and time.

Even after my independent major was approved, my problems continued. I found that some courses that I had included in my plan gave priority to majors in a certain department. In Natural Resources, due to budget cuts, one of the best introductory courses on the environment was limited to majors in that department, which I think lessens the course's value. Other independent majors have told me that they had some trouble getting into "major" seminars and honors programs. Another difficulty is that many graduate schools seem suspicious of interdisciplinary majors.

ATTITUDES OF GRADUATE SCHOOL AND EMPLOYERS

One of the most serious problems is that many graduate schools and employers seem wary of students who have taken interdisciplinary studies and independent programs. Interdisciplinary or independent programs can be so general and unstructured that they provide the student with no specific skills or expertise. A very general background may or may not be appropriate for graduate study; a very general undergraduate background is not acceptable to many employers.

On the other hand, with proper faculty advising, students can design a unique study program not possible under traditional majors, with depth in one or two areas. For example, a student planning to practice environmental law might as an undergraduate combine courses in engineering (land and water resource management, urban planning) and science (biology, chemistry and ecology) with a concentration in economics or public policy. Because the law school curriculum is highly structured, undergraduate years are the only time that the student could choose these broad environmental courses which will certainly aid him in the future.

SCIENCE AND SOCIETY PROGRAMS

Some schools now have partially structured majors or minors in science, technology and society, etc. I am familiar with two such programs. The Science, Technology & Society (STS) program at my old school had promise while I was there, but never achieved its potential to educate undergraduates for several reasons. There was a general lack of knowledge about STS on the part of faculty and students. Most of the courses seemed aimed at graduate students--or if the courses were open and interesting to undergraduates, often these courses were so concentrated that a two-hour course in STS equaled a three or four hour course normally taken by undergraduates in terms of preparation, which caused undergrads already snowed with premed studies or engineering to avoid STS. Departments did not often count STS courses as anything but electives, even though they were taught by faculty from regular departments. Courses varied greatly in content and methodology, so that there was no sequence or major concentration available in STS. Finally, there was no advising staff to help students select STS courses.

The Values, Technology and Society program (VTS) at Stanford provides many more advantages. First, information and course description for VTS are widely available, and freshman orientation gives information on VTS. The VTS office is accessible, as are its staff who have had a wide range of experiences with students from science, the humanities, and other areas. The VTS office has sample programs that other students have designed, both interdisciplinary majors and minors in VTS.

VTS courses pull together knowledge that students have in isolated courses, allowing students to see a larger context for scientific and environmental issues. For example, I am currently taking a VTS course titled, "Ownership, Property and Environment," which is an excellent synthesis of ethical and legal concerns relating to natural resource ownership.

THE IMPORTANCE OF ACCESSIBLE INFORMATION

At a school like Stanford, the student facing the independent/interdisciplinary dilemma has help in finding programs like VTS. First, there is a university office of academic information, which I have found to be an invaluable resource and timesaver. Here students can find student evaluations of every course, as well as faculty descriptions and reading lists. Another list gives the name and phone for a representative in every department who is available for advising. There are also descriptions of special programs like VTS, Human Biology, SWOPSI (Student Workshops on Political and Social Issues) and SCIRE (Student Center for Innovation in Research and Education). Another applicable program for environmental studies is Undergraduate Research, a project coordinated by the assistant dean of undergraduate studies, B. Michael Closson. Students can apply now for about one hundred research slots in sixty areas, ranging from biology to political science. Compensation can be in the form of pay or academic credit. (Please see Appendix I.)

THE ROLE OF THE FACULTY

Besides information on course offerings and programs, faculty and administrative commitment is essential in implementing environmental programs in interdisciplinary studies. At both colleges I have attended, I feel that the faculty do not receive adequate compensation for devoting extra time to innovative student programs. For instance, a faculty member usually is assigned twenty or more advisees from his own department. If he wants to advise interdepartmental majors too, he must set aside extra time for them. Or, if a professor sponsors a SWOPSI course or supervises independent study, he must do this on his own time with no financial compensation from the university. Without dedicated faculty to help, students like myself couldn't design independent majors.

PROCESS EDUCATION: MAKING EDUCATION WORK

If I had to isolate one factor besides faculty encouragement that has motivated me to continue my struggles in environmental studies, it has been my experience outside the formal classroom related to my interests. Most of these opportunities to tackle real life environmental problems came in high school or in summer jobs. They included cooperating with the Open Lands Project, an outstanding Chicago-based conservation group that brought students from high schools across the state to attack pollution problems regionally; helping to organize a student/faculty workshop on environmental problem solving using funds from the Office of Environmental Education; and setting up a program for students to lecture on environment to local elementary schools, as one service of my high school's "Pollution Control Center." These experiences not only made me more committed to the environmental field, but they made education important to me. I gained insights in dealing with people, too--optimism from seeing successful cooperation among people--and realism from experiencing dissappointments in dealing with people and institutions.

Two summer jobs especially inspired me: the summer before college when I worked in the U.S. EPA Public Affairs Office in Chicago, and the next summer when I worked for Congressman Dingell in Washington. In both cases not only were my employers working for the public good and environmental improvement, but they gave me (and other students whom I know worked for them) responsible assignments.

I don't hesitate to say that these two jobs contributed more to my education than most courses I've had so far in college; yet I could not obtain academic credit for either, even if I submitted a paper and documented work for these positions.

I think it is crucial that colleges recognize the value of jobs like these and help students to find them. It is interesting to note that I found both my jobs by chance; neither my high school nor my college had placement assistance in my field.

The most exciting work that I know of to provide college students with these kinds of opportunities is the Massachusetts Audubon Society Internship Program, which has provided jobs for three hundred and twenty students in seventy-five agencies in rural and urban areas. The Internship Program, coordinated by John R. Cook, Jr., a former environmental investigator for New York's Attorney General, selects outstanding students and places them in professional level summer jobs with agencies. Students come from almost every discipline: liberal arts, social sciences, life and physical and behavioral sciences; law, engineering, fine arts, management, journalism, education, computer science and others. The New England projects have included (to name a few): land use planning for the Windham Regional Planning Commission, research on pesticides for Vermont Tomorrow, a tax study for Ecology Action, naturalist work for the Audubon Society, research in an experimental forest for Harvard's Museum of Comparative Zoology, and preparation of maps for the Maine State Planning Office.

The program has been funded by private foundations with matching grants from public and private agencies. Based on the enthusiastic response from the agencies served and the students employed, plans are in progress to extend the program nationwide. I think that the best appraisal of this program is from those people involved, so I have included some of their comments in this paper. (Please see Appendix II.)

THE GOVERNMENT GAP

By providing students with meangingful employment during college summers, the Environmental Intern Program fills a gap that government agencies have left vacant. After talking with representatives from the U.S. EPA this summer, I concluded that EPA grant programs at universities did not involve undergraduates, and that support was available most often for limited graduate work in conjunction with a college department. I understand the importance of research, but I believe that EPA and other government agencies are ignoring great potential by not involving undergraduates in environmental work.

I also feel that much more could be accomplished with EPA's support at the high school level with school/community environmental programs. The EPA President's Environmental Merit Program does not come close to directing these kinds of process education projects. High school students need more than a "certificate of merit" to convince school administrators and the community to support local education and environmental action.

The Office of Environmental Education in HEW has funded many excellent programs, especially on the elementary, secondary and continuing education levels. However, when I called several of the largest grant recipients under PL 91-516 for fiscal '74, I found evidence of only one undergraduate working with any grant proposals; the rest were handled exclusively by professors or community groups. It seems to me that the federal dollar would be better spent for the dual purpose of educating undergraduates and sponsoring environmental programs!

The success of programs like Undergraduate Research at Stanford and the Environmental Intern Program demonstrates students' willingness and competence to tackle environmental problem solving. I think that it's time for American schools, the government, and organizations to give these students the opportunity to learn and to contribute.

APPENDIX I

From THE STANFORD DAILY, September 30, 1974

NEW CLEARINGHOUSE TO EXPAND UNDERGRADUATE RESEARCH EFFORTS

by Roger Thompson

A new clearinghouse will attempt to provide ways for undergraduates with a strong interest in a project to work with faculty in research situations.

One of the main purposes of the program is to increase faculty-undergraduate interaction, according to the program's initiator, B. Michael Closson, assistant dean of undergraduate studies.

Selection for the approximately 100 research slots in about 60 different projects ranging from medicine and biology to political science will be handled by the individual faculty sponsor. But the program will assist students who have research ideas in attempting to find faculty research sponsors.

Nothing more than an interest in the project is required for some of the positions; others necessitate knowledge of lab techniques and subject matter.

Opportunities Directory

Research opportunities are listed in the Directory of Undergraduate Research Opportunities, but supplies of copies from the initial printing were exhausted last week. Additional copies should be available today in the SWOPSI office and the Academic Information Center.

Some of the research positions could be considered full-time jobs, requiring as many as 10 hours a week during the school year and 40 hours weekly during the summer. Others require only several hours a week for a quarter.

Compensation for research work will come in the form of pay or academic credit.

Acknowledging that there exists a danger of tasks for the undergraduate becoming menial and of little academic value, Closson said his office will attempt to insure that the positions remain truly research-oriented.

Program to Expand?

Because the need for undergraduate research help is on the rise, Closson said he envisions the program as two or three times larger next year.

Closson also hopes to find permanent department representatives to provide news of new research programs as they are initiated.

The idea for the service comes from a program at the Massachusetts Institute of Technology now in its fifth year.

Last May a questionnaire was distributed to faculty members attempting to determine their receptiveness to the idea. Of the 35 percent returning the survey, over 95 percent liked the idea.

Faculty Surveyed

Generally, the faculty indicated that students could provide assistance in the implementation of research ideas, and saw the approach as an alternate way of interacting with and teaching students.

About 32 percent said they would be interested in having an undergraduate research assistant if they were required to underwrite the hiring costs.

But almost 80 percent of the faculty members returning the questionnairs said they would employ undergraduates if the costs were covered by the university.

Funding Request

Closson is preparing a request for funding from the University. It will be presented in a few weeks.

Closson hopes to expand the program, which now emphasizes biology, chemistry, and medicine, to include more research opportunities in the social sciences and humanities. Such organizations as the Hoover Institution and the Food Research Institute might also take part, he said.

APPENDIX II*

"The opportunity at this stage of my educational process was exactly what I needed to place my goals in the proper perspective with the goals of other people in the environmental design, and planning field...The summer, as far as I am concerned, could unequivocally be termed a success."

Peter Wargo, MRP '74, Univ. of Mass.
W.R.P.D.C. (Vt.) Intern

"The quality of both interns (F. Lyman, A. Biondi) in performing their self-assigned responsibilities was excellent. Frankly, I have never had two better interns to assist my Division in putting together a summer study of this scope. The interns' usefulness to the agency has been unquestionably total. Without them, the Abandoned Railroads Study never would have been completed."

Thomas Cielinski, Planning Director
Maine Department of Parks and Recreation

"I feel Massachusetts Audubon is to be congratulated for its continued support of this effort...because it offers students a chance to learn about and help solve some important questions."

Tim Sheeran, JD '75, Harvard University
Ecology Action for Rhode Island, Intern

"I think Massachusetts Audubon's internship program has made a potentially valuable contribution to the woefully limited body of information concerning what I consider to be a critical trade-off issue in the environmental/economic dichotomy."

Arthur Ristau, Director, EPIC, Vt.

"The internship set-up fills a void which has been neglected for too many years. It has given me the opportunity to see the range of environmental fields and to work in an area of vital concern. And perhaps most valuable, it has put me in contact with human resources which will be so necessary in future projects and undertakings."

Cheryl Barton, MLA '74, Harvard University
Mass. Dept. of Natural Resources, Intern

*From Massachusetts Audubon literature

"Tim Sheeran was innovative, not only in his own program, but in the overall operation of the organization. The citizen's organization that grew out of Tim's effort and which continues to function today was cited by EPA personnel at a public hearing as the most effective such effort in New England."

Dr. Harold Ward, President
Ecology Action for Rhode Island

"The Noyes Foundation supports several similar internship programs and we think yours stacks up with the best of them."

Mrs. Edith Muna, President
Jessie Smith Noyes Foundation

"Miss Reavis is an extremely bright and creative person, able to work with a minimum of supervision but at the same time responding well to direction...Our office was fortunate to obtain Miss Reavis as an intern and she made a substantial contribution to our work efforts..."

COOPERATIVE ENVIRONMENTAL SCIENCE: SOME SECONDARY AND UNIVERSITY PROGRAMS

Robert S. Cook

In both the Environmental Education Act of 1970 and that of 1974, the U. S. Congress stressed the need for environmental studies programs, especially in our nation's K-12 systems. The 1974 act reinforced the initial act by stating in its guidelines that environmental education programs should include the following:

a. problem solving
b. student participation
c. stress on local environmental problems where the class becomes involved with the community and the community with the class.

How one university system is attempting to assist some secondary schools in implementing the above is the subject of this paper. It is hoped that these tested examples may serve to assist others in developing and implementing environmental studies programs.

First, some background information on the University involved is necessary. The University of Wisconsin-Green Bay was legislated into being in 1965. Planning during the subsequent three years resulted in a University academic program that was unique and well designed to meet the changing demands being placed upon higher education at that time--namely, relevance of subject matter to real problems, and the personalizing of the students' education.

Thus, people and the problems associated with their natural and man-made environments were selected as the core of the entire UWGB academic plan. Becoming proficient in a disciplinary area (called an option at UWGB) would not be sufficient. Environmental education is a process in which we use the disciplines, since finding solutions to most environmental problems requires multidisciplinary study. Therefore, each student would have to learn how to apply his/her knowledge in formulating alternative solutions to environmental problems. Under the plan, the student builds an academic program around a broad problem of the physical, biological or social environment (called a concentration at UWGB), rather than a standard disciplinary major. The courses selected

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Robert S. Cook is Associate Professor of Environmental Science, University of Wisconsin - Green Bay.

may be in a variety of fields--as in a traditional university program--but they must be able to relate the knowledge acquired to the problem area chosen for study.

With such a heavy emphasis on problem-oriented education, it is quite evident that learning situations involving problems could not be easily contrived in the laboratory. The student must go where the action is--to the community--not only to observe and learn, but to contribute to society's needs whenever possible. If their learning experience can result in a service, the sense of achievement and social responsibility on the part of the student is not only developed, but is intensified as well. The drudgery of learning becomes submerged in the excitement of doing something "real".

A vital part of the UWGB plan is the Liberal Education Seminar (LES). This program runs as a thread through the entire four years and helps the student, regardless of the chosen area of study, to relate the academic preparation to the real world.

During the freshman year the seminar addresses a variety of topics ranging from _Man in the Biosphere_, to _Technology and Human Values_, to _Resource Utilization and the American Character_. It is during these seminars that students begin to identify the classic concepts and components of ecological problems and to examine them from various viewpoints. Many community persons serve as resource people in this program.

During the sophomore and junior seminars each student restricts study to a topic of choice, usually in the problem area in which he/she hopes to concentrate. An off-campus project is a requirement, and the student examines the chosen field of study in some detail, usually for the first time. This necessitates a careful community liaison and northeastern Wisconsin has given full cooperation to this program. Industry, agencies, business, schools and many others are taking the time to talk with students and to help them achieve a better understanding of their chosen study areas. One of the secondary education programs I will discuss later resulted from the LES program.

While the academic plan stressed the understanding of environmental problems and their solutions, it soon became evident that only a small number of entering freshmen had been thinking in terms of problem-focused, interdisciplinary, community-oriented education. Consequently, UWGB began to develop ways of introducing the environmental education concept into elementary and secondary school programs. In developing the secondary level programs we strived to involve UWGB faculty and students with school teachers and students in projects where they could work and learn together. Also, the passage of the Environmental Education Act of 1970 gave impetus to this thrust. Following are examples of our efforts which involved secondary schools.

As a part of the sophomore LES course in Environmental Science, UWGB students and their instructors selected for study a small 140 square mile watershed located within 20 miles of the campus. The watershed is primarily a region of dairy farms. The river itself has the potential of becoming one of the finest cold water streams flowing into Lake Michigan. Poor agricultural land-use practices and inadequate sewage treatment facilities appear to be the primary physical problems. State and federal requirements are causing the communities to upgrade their sewage treatment procedures, but land-use reform is slow. Spring run-off, inadequate handling of animal wastes and lack of stream bank protection are major concerns.

Socio-economic problems appeared to be a decrease in farming, high unemployment and an out-migration of young people. Also, the county did not have an aggressive plan for the future. However, the U. S. Soil Conservation Service had been conducting a feasibility study with the County Board on the possibility of federal funding for a Public Law 566 project which would provide water retardation structures to control siltation and flooding. Very little concern for socio-economic problems would be involved in the proposed program. It was shortly after the SCS feasibility study had been completed that UWGB contacted the County Watershed planning committee and became involved.

One problem with PL 566 projects is the lack of resources to conduct adequate data collection studies necessary for exploring the total problem and alternative solutions. The committee welcomed the offer of students to gather data and to share in the evaluation process.

A series of informal meetings were attended by citizens, faculty and students from Kewaunee High School, one of the two secondary schools in the watershed, and UWGB. The initial concern was the area of responsibility of each. Here it was critical to keep each group working on the project without becoming the dominating force. The following five guidelines were worked out:

1) High school and university students would be directly involved in collecting and analyzing physical, biological and socio-economic data.
2) University students and faculty would help high school students and faculty by providing seminars, laboratory facilities, and some leadership of high school teams.
3) High school students would be appointed to the citizens' watershed planning committee with full voting privileges.
4) Both high school and university facilities would be used to analyze data and an independent testing laboratory volunteered its services to verify measurements.
5) The high school students would begin a campaign to inform and involve the community. This was to be initiated through news

articles and public speaking engagements. Here university personnel would also participate on invitation.

During the first summer, 1972, a course was taught at UWGB entitled Environmental Awareness. There were no prerequisites and high school seniors as well as university students enrolled. The purpose of the course was to acquaint students with the watershed approach to problem-solving and to give them first-hand experience in getting acquainted with the area; namely its biological, physical, and socio-economic characteristics. Also, techniques in data gathering were discussed and performed on a trial basis.

The results of the summer course indicated a real potential for the project and it was accepted as a full UWGB sophomore LES course during 1972-73. During that year, students spent the first semester getting to know the problem through a variety of lectures by community and University people and by numerous discussions and field trips. The second semester they chose a particular part of the problem and designed a field experience which they performed. They were encouraged to work in interdisciplinary teams and to involve community, high school and University resources whenever possible. Many UWGB senior science students became interested and volunteered to lead teams in their investigations. In this way, students are learning from their peers as well as by experience.

In addition, other faculty have become interested in conducting research on various problems in the watershed, e.g. in climatology, soils, wildlife, and economics. This makes additional data available and adds new dimensions to the project.

The relationship between UWGB and the high schools has developed steadily. The Kewaunee High School program has grown from several students working outside regular class hours to a full summer course in 1972 to a now regularly scheduled credit course. The other secondary school in the watershed, Luxemburg-Casco, is beginning the same process and problem oriented education is becoming an established part of both schools' curricula. Mr. Fred Schroeder, Kewaunee High School biology instructor, has written several reports on the secondary schools' involvement and progress.

In January of 1974 the SCS announced the second phase of their PL 566 project. That phase recommended five sites at which dams might be built on tributaries after sufficient land-use practices have been implemented on the upland. They were seeking more precise information on the biophysical aspects of each site in order to decide whether or not the benefits will be greater than impoundment damage. UWGB and Kewaunee High School students cooperated with the Wisconsin Department of Natural Resources in collection of the data. The students then attended an open meeting in May, 1974, where their findings were presented and discussed.

Recently there has been a reorganization of regional planning commissions in Wisconsin and the new office in Northeastern Wisconsin, which includes Kewaunee, is very interested in the project. This planning agency will add another new dimension that will be invaluable for program continuity.

This type of project allows an ongoing program to be used as a learning situation for students year after year. The written reports, faculty and interest of upper-class students in returning to help, provide continuity to each succeeding group. Each group feels a sense of accomplishment as well as learning--an ingredient we find of utmost value in the educational process.

Session 2

WHERE ARE WE IN ENVIRONMENTAL EDUCATION? VIEW FROM THE CITIZEN

Phyl Smith

First of all, which citizen? I assume we mean that great heterogeneous number of people which make up the out-of-school adult public. A small number of these citizens work in groups to protect the environmental values they prize and will actively seek their own environmental education. The vast remainder are dependent for their education upon whatever information is provided directly to them and upon their own decisions to respond to it. In both cases every citizen is constantly making decisions affecting environmental conditions. My remarks today will be from both citizen viewpoints--one attempting to influence and the other being influenced--in terms of individual environmental decision-making.

Many of you here are involved in technical fields and undoubtedly approach academic environmental problems with the traditional scientific method of inquiry. My background as a citizen activist included two professional scientist parents, my own scientific profession, an engineer husband and, therefore, an unquestioned acceptance of the scientific method as the proper approach to life. Even after moving to a town with no good professional job opportunities and no institution of higher learning (the nearest one is 50 miles away and we don't communicate), I instinctively involved myself in an organization which utilized the same approach in its goal of solving selected public programs. The League of Women Voters prides itself on its ability to define the problems, collect facts about them from a variety of sources, objectively evaluate the facts and come to conclusions--but it goes further and attempts to solve the problems by emphasizing the necessity of effective political action to implement its conclusions.

However, after years of applying these techniques within and without the League framework with seemingly more failures than successes in accomplishing change, and deciding only that we hadn't worked hard enough, it became apparent that something else was needed other than just more of the same hard work. Why, if the facts made sense to us, didn't they affect others the same way? And is that not, essentially, what academia finds itself saying--not directly to citizens, but to different parts of itself, to governmental agencies, to business, to lawmakers?

Phyl Smith is a charter member and former vice chairman of the Association for the Humanities in Idaho, an agency of the National Endowment for the Humanities. She owns and operates a bookstore in Idaho Falls, Idaho, and was formerly a member of the National Board of Directors, League of Women Voters.

Since that time my personal involvement in a special kind of retail business, a bookstore, and my organizational involvement in the programs of the National Endowment for the Humanities have been revealing and rewarding to my concern about the human decision-making process and how it is influenced. The humanities are concerned with helping people understand just what it is that is really important to them, why that is so, and how different values can filter the same facts and produce different decisions about them. Additionally, the humanities tend to encourage communication on a feeling rather than an intellectual level; this kind of communication allows everyone to possess a non-debatable position and the discussion can proceed on the basis of sharing individual problems, goals, anxieties and pleasures which can produce a mutual understanding of conflicting intellectual positions--and even a comfortable resolution of them.

Have you ever seen the value-development process actually happen? I was fascinated by participating in a simulation game which illustrated our very natural spiral progression from our initial emotions and anxieties to our need for protection of our values (what was really important to us) to our broad subjective views of society and our own relationship to it. The human decision-making process was operating, but it was not operating the way I was taught it should.

A bookstore is involved in communication too, and it offers easy ways to observe where people are. In terms of being environmentally educated many people reflect their need to take individual, non-governmental action to live with a guarded environment by buying a great number of books about how to be self-sufficient with nature. And at least half my customers indicate they are aware of the timber-energy-paper-energy-solid waste disposal-environmental degradation process by saying they can do without a paper bag for their purchases when given a choice, with younger people saying so more often than middle-aged ones.

But bookbuyers are readers by choice and therefore information-seekers. Other citizens are not, but all of us are living an integrated environmental life, making decisions all the time which involve whatever environmental awareness and education we may have and our personal economics. In this we are way ahead of much academic institutional life which I hear still needs to think about its environmental education in significant interdisciplinary ways. What kind of information, then, do we have to use in our decision-making process and where does it come from and when do we decide to be influenced by it? We may know that we should decide carefully, but the conflicting solutions to environmental problems offered us lead only to confusion. Most information, especially that politically oriented, seems to attack one recommended solution over another as being evilly inspired. Citizens so assaulted usually respond negatively to the whole mess and we may well make our decisions in the least stressful way we know, regardless of environmental impact. No one has provided us with either a current analysis of the problem itself, or, even better, with a compendium of usable information which encourages us to define it ourselves. Without that understanding, we can easily see any proposed solution as clothed in suspicious motives.

How do you as educators, technical or otherwise, decide what is the best way to educate those who educate us out-of-school citizens? If I have heard correctly, I believe you really haven't decided among yourselves yet. But first, may I ask if you really want to? While I doubt that the reply could ever be "no," the results of academic behavior could indicate just that. After all, this society teaches us to strive for competence, and possession of information demonstrates some kind of competence and with it, status and power. Sharing that information may be a quick way to lose that competency-status-power position, so information gaps are often created and maintained. Evidence? Notice to what extent the specialized languages are used; does that use guarantee understanding or prevent it? Does then, the hierarchial educational system have a need to create and maintain educational gaps all the way down to the citizenry? The real question may be: if we citizens are dumb and uncaring, why? If you really want an educated citizenry, you will get it.

If as citizens our everyday lifestyle decisions as well as our official voting decisions are important, what kind and form of information are usable to us? Can you show us how we use our value systems to create an environment and then shape new values from its impact upon us? Can you take us from where we are--

geographically -- at home, on our way to work, on the job, in recreation;
economically -- spending our money, with those options and tradeoffs we are aware of;
physiologically-- functioning, as best we think we can;
psychologically-- with the goals we hold, the pleasures we need, the overt and covert worries we have;--

and show us goals for better living? Beyond the basics of security, what are they? In everyday terms, not philosophical ones, what differences will it make to us, immediately, if we learn more from you? How challenging are the goals? How hassling? Once we accept the goals and define the problems, our process for reaching solutions must be both personally exciting and personally rewarding--an ego trip, as it were--for us to maintain our interest and momentum and effort.

Someone also will be deciding for us about the format and the means of presenting your information--to which we are expected to respond. Some of us are readers--it's a nice, quiet activity--and two-way discussers, not passive viewers or listeners. Others are the opposite: television keeps them company and doesn't argue back. Readers can usually read in depth when they want to and decide to take time to do so, but with limited time they would respond with gratitude to, for instance, cartoons which give them succinctly the same basics about a problem and solutions to it which they could eventually glean from a longer article; if they got around to reading it, that is. But non-readers respond to cartoons too, so that approach could reach everybody.

In addition to education about goal specifics, we need technical help through regular, consistently-presented progress reports, such as the already fairly common air quality indices which are much improved in format to be visually exciting and to convey a sense of important individual involvement. Again, cartoons in newspapers and on TV with progressive information on the status of a goal, showing what investment of money was, or was not, accomplishing and with an added "humanities" touch--a statement from the past, a current quote, a related incident comment, a bit of appropriate folklore--could attract and influence us both intellectually and emotionally. But do check with us to find out if you're coming across.

And we need a flow chart for our access to power for changing environmental situations;

--where to go to find out what the problem we notice may really be;

--where to go for getting action on it (a common environmental problem attacked long ago is garbage pickup: almost everyone knows what to do and does it about the failure of the immediate solution to that problem);

--how to check up on the results of our investment of time and effort.

If environmental information is valuable to citizens in their everyday lives, we will have no problem using it and will then be described as being environmentally educated. If educators will--not can--translate and transmit their specialized environmental information through our various value systems for general discovery of common goals and methods of reaching them, demonstrating both by example, surely we will all be further along in learning to survive, not minimally but optimally.

INTERFACE:
HOW CAN INSTITUTIONS RELATE TO EACH OTHER IN ENVIRONMENTAL EDUCATION?

Panel: David A. Kennedy, Rosemary Richardson, Frank Nicol,
Laura Williamson, Tom J. Bartuska, Robert O. Sylvester

DAVID KENNEDY:

From my perspective, it is essential to have support from all facets of society as we attempt to get environmental education programs together and moving. Getting support on a broadly cooperative basis is, as you well know by now, a very, very difficult task and it certainly has not happened yet. I think there are some signs that there is hope on the horizon and that we have begun to get a handle on how to do this. There are lots of ways to approach the problem. I would like to briefly treat just one today.

I contend that the adoption of a formal policy statement of agencies seeking to relate to each other for environmental education purposes is vital to the ultimate survival of that relationship. It is necessary, although not sufficient by itself, to the actual accomplishment of any far-reaching or long-term goals.

I am concerned with something more than just a casual relationship between agencies and institutions. I want something that is much more definitive. A policy is any plan or course of action adopted by a government, a political party, a business organization or institution or the like designed to influence and determine decisions, actions and other matters. The adoption of a written policy statement as opposed to an informal understanding (or merely something that an institution does, something informal), is important, because it can bring legitimacy, and thereby, more hope for viability as we look toward courses of action. Needless to say, a written policy does not guarantee viability. Policies, written or not, can be overridden. We see them overridden all the time at all levels of government. They can be brushed aside, forgotten, or come into conflict with other and stronger policies. In practice, however, and in the context of developing an inter-institutional environmental education policy, the adoption of a written policy supporting the program can become a very powerful bargaining tool. At the

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very least, it can become a start and I think that is really what we are looking for: a place to begin.

I suggest that the first or the initial policy development should be characterized as low-key, nonspecific and evolutionary as opposed to revolutionary. An ardent supporter of environmental education may find such a policy lacking in substance, color and emotion and, most of all, lacking in the kind of strong commitment that he or she would like to see given to this cause. The policy should be designed to be acceptable to institutions (bureaucracies, if you will), and its major strategy might be called political. Recently, politics has been referred to as the art of the possible. You can play with that one if you like.

Of course it is dangerous to generalize about all institutions with respect to their receptivity to innovations, but experience demonstrates that adopting and implementing new policy is more possible when the policy is considered safe rather than revolutionary, no matter how worthwhile the goals of said policy might appear to be. I won't belabor the point, but perhaps a quote from one authority on policy might suffice. In Sharkansky's book, Policy Analysis in Political Science, Ralph Huitt states that "....Low political feasibility must be attached to whatever is genuinely new or innovative, especially if it can be successfully labeled as such, and more importantly, if it rubs an ideological nerve. What is most feasible is what is purely implemental or can be made to appear so, or can be made to seem a comfortable next step under a program which has already received a good conduct medal."

Maintaining a low profile may be even more important today when institutions and bureaucracies, like the rest of us, are suffering from the inflation, stagnation, recession kinds of jitters. Hopefully, however, the first or the initial policy can do the job. The initial policy can allow an agency or institution to commit support to an environmental education program.

I recommend a rather blatant attempt to show that the new policy is in fact more or less a continuation of at least two previous institutional policies. For example, let's take a state agency that manages some kind of natural resource, because we are always dealing with those kinds of people. A safe approach for them to take might be to amend policies that treat (1) informing the public, and (2) cooperating with other state agencies. They have always done those things; they always will.

I don't think that mention should be made in the first or the initial policy statement of how much the institution is going to contribute to the program. I think that is dangerous. Herein lies an admitted weakness of the policy, if one means a more or less comprehensive plan. One of the dangers of selling short such a project as this at its inception is that it will never get off the ground, or if it does, it will never go anywhere. Ideally, any educational endeavor should be thoroughly planned with specific goals and objectives and with an adequate budget to obtain the same; and yet, specifying necessary if additional resources now could quash the entire proposal. We have found that it is much more effective to be purposely cautious and successful than to use a disruptive and threatening approach. An answer to this dilemma is that something is better than nothing, but a better answer might be that the project will fly or not on its merits. That is what we are hoping for; that it will fly because of the merits of the kind of program it is.

I feel that an inter-institutional environmental education program will succeed to the degree that each institution contributes to it, and that in turn, each institution will contribute as much as it can when it is convinced that the program does indeed benefit itself; all the participants must have a satisfactory answer to the question "what's in it for me?" The institution has to understand that, and hopefully it will lead to some of the results demanded by that institution's charter, or that institution's mission statement. This is a very important part of this policy relationship.

The public relations job of securing adequate resources, then, is seen to be a continuous process rather than one which is settled once and for all at the inception of the project or the agreement between the two institutions (or as many as exist in an agreement). In a like manner, the tasks of planning, development, implementation and evaluation will be conducted continuously through the life of the project, building upon project successes and hopefully learning from mistakes. A legitimate inference which could be made from this approach is, that within reasonable limits, institutions will embark upon a program with more or less the same amount of material and personnel resources that they now contribute to allied endeavors. The hope and expectation is that current resources will be used legitimately and more effectively. It would behoove institutions, I feel, to live within these constraints until they demonstrate that additional resources will be used wisely and well. At that time, well, this suggested approach does not mandate a minimum level of support, but neither does it limit maximum kinds of support.

In summary, agencies and institutions involved in any cooperative arrangement need to share their human and material resources in a legitimate manner. They can't "bootleg" it any longer as so many of these institutions have done. They traditionally charge it to something else, call it something else, but do environmental education; I'm afraid that isn't going to wash any longer. Environmental education activities need to be consistent with an institution's other duties, functions, programs and responsibilities; and finally, the inter-relationships between institutions need to be formally cemented with a policy statement in order to achieve those far-reaching and long-term goals that can be agreed upon by institutions seeking to relate to each other.

ROSEMARY RICHARDSON:

I would like to speak today on how I see the role of the community college more than on what I have specifically been doing. I feel that the two-year college can have a three-part role in environmental education. I think that we can be involved in technical training, training people as operators and monitors for industry, government and various institutions. I think we can have a role as an academic base or core for those students who are in academic transfer programs and for those students who complete their formal education in community college. I also think the community college can play a tremendous role in public service and community activities. To expand a little bit, I think the community college is an ideal place for cooperative or work-study programs in training technicians to work in government fields of monitoring water pollution and air pollution--in other words, these people that we are now training to operate machines. In the community college not only can they learn how to operate machines but they can also receive a background in what it means. We talked a lot this morning about values. I think we can get some of these values in addition to just plain technical knowhow of monitoring equipment.

I think the second thing the community college can provide is the academic background in environmental education, both for those students in academic programs in the four-year college and those who are finishing their education with us. The greatest problem that we have in this field is that we get both students in the same course. The needs of both groups of students must be met. We are supposed to give students awareness of environmental issues: how to make good decisions when reading the newspaper, when, as was suggested this morning, we go to the polls. How are we going to decide? The community college can provide this by creating an atmosphere of awareness. The area of transfer programs is more difficult. At this time I don't see the community college as having the capacity, the multidisciplinary expertise to provide a two-year program in environmental education. I think that today, anyway, we have to leave this to the four-year institutions. They have the research expertise, they have the experts in the multi-disciplinary fields, that we at the two-year colleges often lack. I'll speak a little later on how they can help us.

The third role of the community college is in the area of public service and community awareness. The two-year college has the greatest access to the most people. We're in the communities. The four-year colleges are not as prevalent.

Rosemary Richardson is an instructor of ecology, botany and general biology at Bellevue Community College (Washington), and has participated in courses and institutes in science and environmental education.

We are there. Our experts can play a central role, by means of public service programs, seminars, workshops, and short courses, as well as providing advisory personnel for community groups, for local government, for our public schools. We can also assist in local industry development. Community colleges should be community oriented. We must become more involved in this field. Most community colleges today are not. Overall, I think the greatest problem we in the community colleges today are facing is in educating the community college educator. Most of us who today are teaching environmental studies programs in the community colleges were tapped to do this job because we were there, when someone in 1970 or 1971 said, "We need to offer courses on the environment." Many of us do not have multidisciplinary backgrounds. Many of us do come from a science background, but as we've heard today, several times, we need also to include political knowledge, economic knowledge, human values. Many of us don't have this background. This is where I suggest that we can work in conjunction with four-year institutions to provide a broader base for us, the educators. We could do this by having special programs, or summer workshops, perhaps funded at state or regional levels, which would provide an access, a source of expertise for us to broaden our own background, to update the knowledge we acquired several years ago in formal education. I think also that we could form environmental education associations. The purpose of these would be to disseminate information, to update, to broaden backgrounds. Lists would be valuable, of where the experts are. Who can we tap for specific knowledge? Again, summer programs would be a good start for this. Funding for the community college is often a difficult problem. Our funds usually have to come from state budgets. We very seldom get research funding from national or private foundations.

So, in conclusion, I think that the community college can and should play a vital role in environmental education. It can become a part of the enlarging network of institutions that communicate with each other in this area and especially in public service to the communities of which we are part.

FRANK NICOL:

I'm not going to provide you with a success story, in part because we're still in the middle of developing it. I'd first like to indicate a little bit about what

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Frank Nicol is Director of the Environmental Studies Program at Eastern Washington State College (Cheney), was consultant on environmental affairs for EXPO '74, and is a member of the Board of Directors, Washington Environmental Council.

I'm doing at the institution because it sets the scene, I think, for what we're trying to do in the community.

The first job, because I'm developing a multidisciplinary program, is to break through some of these restrictions we face, because of our overspecialization. We're attempting to produce an umbrella organization and, while I'm resisting an attempt to develop a major, I am advertising those courses in the various departments that have environmental associations. At the same time that we're playing a low-key position at the school, there is the problem of survival within a bureaucracy and I'm not exactly sure what I'm going to have to do in order to develop the visibility that is needed. This same attitude is being transferred to the community, and as in Phyl Smith's request, what we're trying to do with the environmental groups, is to show the adults, the adult groups, how, when, where, what they have to do in order to be effective.

I heard the admonition earlier about not becoming too active with the groups. I'm sorry. I'm an environmental activist. After you decide on what you're going to do, by golly, you have to go and do it. For the groups to have some continuity, however, we try to encourage them to develop their own action programs.

We have had some exchange in instruction between different institutions, but this is done on an irregular basis. There is a request, now, to bring a consortium of schools into a research program. We do advertise our special abilities at the schools.

For example, we have indicated what our library acquisitions are, so we prevent undue duplication.

We are organizing discussion groups between the institutions.

With the special support of my institution, and encouraged by various of the environmental groups, I took an active role in trying to help the business community to legitimize the environmental theme for EXPO '74. I have learned a lot.

One of the things I have done recently, is to try to bring foreign visitors to all of the area schools (I'm talking about the Northwest in this sense). For example, the recent Russian visitors, those that came here to help in developing the environmental viewpoint statement: one group is now touring the northwest part of the state with the National Park Service, Forest Service, and Western Washington State College. I understand that some of the personnel from the University of Washington will be there with them. Yesterday we hosted four at Eastern. On Saturday, there will be a contingent at Whitworth in the morning and the same group at Gonzaga in the afternoon. Another group is with Washington State University today looking at Hell's Canyon and some of the areas down there. And on Sunday, a trip has been organized to view Grand Coulee Dam and the whole Columbia Basin Irrigation Project.

Finally, an effort that is being made now is to develop a consortium, not only of the educational institutions in the area, but of various appropriate groups--environmental, civic, and so on--to produce a program that can be used as we try to take advantage of the new interest in the environment and to see if we can continue this kind of thing into a program for the future, particularly as we acquire a permanent facility.

In my own case, and I don't know how people in other institutions feel about this, innovation is not recognized, particularly within the state system, where the Council on Higher Education is asking for greater and greater evidence of educational efficiency. This is measured in terms of the number of students you can accumulate around you. I think we all are going to have to ask for permission to become involved in innovations, because this is the only way in which we're going to develop programs that have some relevancy.

LAURA WILLIAMSON:

I am the manager of the Environmental Education Center at Portland State University. The EEC is the result of the most difficult kind of inter-institutional cooperation: cooperation among institutional business offices. I, and two of our staff, work for the Oregon State System of Higher Education; our director is an administrator from Portland Public Schools; and our secretary is provided through a Hill Family Foundation grant to the Oregon Museum of Science and Industry.

There are several reasons why now, more than ever, we need to look at ways in which we can share across institutional lines:

First, the problems we face are so much larger than the resources allocated indicate. One of the ways we can become more efficient with our limited resources is by eliminating duplication. Right now, this is supposedly being done for us by our legislatures and funding agencies--but I don't think we should rely on their judgment alone.

Second, with many of our environmental problems, we can't afford the time-lag between when someone first notices a problem and the time when we set up a new bureaucracy or program to deal with the problem. Each new institution we must invent really represents the failure of existing bureaucracies and programs to communicate, cooperate, and remain flexible.

Laura Williamson is Manager of the Environmental Education Center and Research Assistant at Portland State University (Oregon). She was a member of the working committee for the EXPO '74 Environmental Symposia Series and has been an environmental consultant to many groups.

Third, we in environmental areas should know better than anyone else: every problem is interconnected with every other problem. Some of our greatest failures in the past have been the result of separate institutions undoing each other's works or creating new problems for each other as each tries to solve its own problems. If we are really to address our problems holistically, we must either drastically overhaul our existing institutions, or we must begin to communicate and cooperate across institutional lines.

Initiating communication or information-sharing is surely a tough task to attempt without threatening your own or somebody else's institutional integrity. Everybody is sensitive to someone else's empire-building attempts. Many of the most energetic movers are those people who are least aware of their own "conquering" style. Exchanging information is the first step in cooperation. First you must know your or your institution's long and short-term goals, program needs and activities. All too often we discover these as the result of, rather than as the prework for, communication with someone else. You must, then, learn where the other person stands: what are his long and short-term goals, program needs, current activities, skills, resources, and connections? Once you and your potential co-worker have all of this information, it is then up to you to identify for yourselves the possibilities for cooperation. While I'd like to see a new ethic in both personal and institutional relations based on notions of synergy and symbiosis, I'm not holding my breath. Cooperation really only works when everybody has a say in the planning and when everybody can clearly identify the benefits they receive.

We at the Environmental Education Center have found that it is easier to initiate communication with another group if you have a little free space or neutral territory on which to meet. One of the EEC's functions is simply to maintain that bit of neutral territory--that spot interstitial to existing institutions. We are able to maintain this role for several reasons:

First, this is one of our primary goals. Believe it or not, it takes energy to stay out of environmental and educational controversies. Much of our work is directed at simply maintaining communication channels and serving as an information clearinghouse.

In addition, we take the initiative in identifying potential areas of group cooperation and in setting up meetings or events which will encourage cooperation among groups and individuals who would not ordinarily meet.

Second, a large number of different organizations contribute rather small amounts of time, energy, and resources to EEC programs. This encourages everybody to feel that they have some stake in an experiment such as ours without taking very much risk.

Third, the Environmental Education Center is future-oriented. There are several foci you can use to organize for cooperation and communication, but two key requirements are that the focus be exciting and that your focus be in "unclaimed" territory. One of the most heavily-used organizing devices in the environmental movement is the crisis. The general focus that the EEC uses is that great unclaimed territory--the future. Rather than trying to encourage people to talk together about the similar projects they have already developed, we try to bring people together who might be interested in the same new possibilities, funding sources, ideas, opportunities, or technologies. We have found that our future orientation and our status as an education experiment, make it easier for us to maintain a center for communication and cooperation.

We're currently involved in a regional experiment in communication and cooperation called Northwest ECONET. The rationale and many of the techniques I have mentioned are the basis for this Environmental Education Act and Hill Family funded project. The purpose of the Northwest ECONET project is to identify, enhance, and extend the environmental communication patterns in the Pacific Northwest. Our monthly newsletter, RAIN, a Portland ½" video access center, the SHARE public computer directory to be demonstrated next week at EXPO are all part of this effort. A final component is a series of brainstorm meetings being held in different areas of the Northwest to develop regionally-oriented, inter-institutional, Bicentennially-oriented environmental education projects.

TOM J. BARTUSKA:

In the allotted time, one must make a very short response to a very significant question. The interface is a fundamental concept to many aspects of environmental education. It is an important need in our very young, developing history. The interface, as ecologists and students very appropriately express it, is "where the action is."

In mountains of platitudes, statements and words, I always tend to go back to basic ecological principles which are challenges to the assigned topic. These ecological principles are too simply stated as follows:

(1) Holistic premise to problems
(2) Interrelationships, integration
(3) Limitations, growth within a finite resource base

Tom J. Bartuska is chairman of the Environmental Science Program and Associate Professor of Architecture at Washington State University. He has done research in ecological bases of planning and architecture, and has been a member of the City of Pullman (Washington) Planning Commission.

Briefly, I would like to examine the basic topic of "The Interface: How Institutions Can Relate to Each Other in Environmental Education" with these three basic concerns.

What is our holistic concept or premise? There is a need for integrated access programs in environmental education at all levels of our local and global society. We must in varying ways establish an interrelationship among all elements in our society: each person--each student, each household, each school, each neighborhood; each city, county, regional or comprehensive university (of particular interest to us today); each state, all nations, and the world. Each of us in environmental education must help and contribute to the establishment of access programs to all of these elements in our society.

In perspective, looking back over the last five or six years that Washington State University has had an active program in Environmental Science, there has been progress in developing environmental programs for these diverse societal needs. Some programs have been good and some bad, our progress may be too slow for some and too fast for others, but still there has been progress at almost all scales in society. People are becoming increasingly aware of the environment, some in a mature way, others in a false way. There is much work to be accomplished here. Citizen participation is a new spirit of our time...at another scale, this symposium is an attempt to bring together programs in higher education. There have been many others...and at the most important scale, the world is beginning to focus on global environmental problems through population, water, food and habitat symposiums.

Due to the economy of scale, a general concept which may relate to this holistic premise is that institutions should work together and support establishing programs which are broader in context than each institution in itself. Universities should organize to establish state, intrastate, regional cooperation; national and international programs. Due to other economies, individual institutions should help other institutions at the lower scale, i.e., a university could assist and encourage its regional community in supplying resources to help develop unique programs within their "sub-units" such as community organizations, high schools, junior colleges, etc. These units should be encouraged to organize to define their needs for institutions of higher education.

Appropriate interrelationships for integration are very important at all levels. We have sets of choices: we can institutionalize these interrelationships and make them permanent, or we can use the simplest means of openly sharing information and resources, involve community action and citizen involvement to establish this interrelationship. All of these methods take quite a bit of preplanning, but the latter may be a more evolving natural process to follow.

Limitations, what are the limitations? When I come to conferences such as this and participate in discussions about environmental education, I go home feeling pretty good. I strongly feel that we at Washington State University and in the Northwest region have developed a conceptual framework which "has the marbles in the right pocket." When I get home, I find that we have problems in "managing those marbles." Studying the tremendous societal needs and the growth of environmental education within a finite resource base forms a perplexing dilemma.

At Washington State University, our Environmental Science program is gaining student interest and university support faster than other departments in the university. This, within a finite resource base, requires redistribution of resources, which causes institutional competition instead of cooperation. This, of course, is destructive to interdisciplinary cooperation, a fundamental concept of environmental education.

The organization of the "interface", or establishing appropriate interrelationships between environmental programs, will make the overall movement more stable. Sharing resources may minimize duplication and waste of these same resources. This is dependent upon what economy of scale we are dealing with.

Internal to a large university, we have developed many ways of managing our resource. The key concern I bring to this conference is ways of managing your own household. Our program interrelates three colleges, some ninety faculty from some forty different disciplines. By managing well one's own household, one can minimize the energy-consuming problem represented here, i.e., "the value of an expert is proportional to the distance traveled." One must first of all find ways of gaining accessibility to the regional context, the university as a resource base for inter-university and community matters.

At the smaller scale, we have developed some programs which involve the community through its school system and citizen organizations. We need to do a much better job in this area of concern and could use your help and suggestions.

At the larger inter-institutional scale, I suggest participation in programs such as ECONET and SHARE, programs which are attempting to coordinate a data bank, public relations and communication programs, and resource crisis exchanges within the Northwest region. This is the type of program which is larger in scale than the institutions and needs to be collectively supported by institutions. There seem to be economy and effectiveness in coordinating these types of inter-institutional programs.

Another important program in the Northwest is the newly established Northwest Association for the Environment, an association of institutions, their students and faculty within the Northwest dealing in the area of environmental education. This promises to be an important organization beginning to develop inter-institutional programs. It is a beginning in the Northwest. There are many problems: in fact, presently we can not even agree upon an organizational name.

It is not any one of these programs which seems important to this conference now, within the broad context of environmental education for our local citizens and our global community--it is all of them. I briefly suggest these thoughts and encourage further exploration of any of these programs through the seminar's discussion.

ROBERT O. SYLVESTER:

Institutions having an environmental studies education program can relate to one another in several ways, and there are good reasons why they must relate. These remarks refer to institutions which have a well-identified program in environmental studies that includes teaching for both the undergraduate and graduate student, research and public service. By their very nature, these programs are of necessity interdisciplinary. In the setting of traditional degree programs in the conventional university or college, the environmental studies program is very new and quite non-traditional. Each institutional program is essentially staffed with faculty who have recently come from or remain associated with a degree-granting department. These faculty are now in an interdisciplinary setting where there are no models or norms for program development as there are with the traditional academic fields.

In the development of an argument to show a necessity for "relating", it should be pointed out that environmental studies as a discrete program is not universally accepted as being a good thing or as being necessary. Some feel that the subject is being adequately handled by regular departments; that the environment is so broad a topic that there can be no rigor in its development; that the environmental concern is a passing fad; that there will be no or few jobs available to anyone with such a major; and that in these times of fiscal restraint and reducing student enrollments, universities should not embark on any new and competing programs. I strongly disagree with the foregoing arguments and, further, feel that an environmental studies program is also one of the healthiest things educational institutions can be doing as a means of fostering interdisciplinary interactions--preventing themselves from further becoming inflexible, stereotyped graveyards.

In my opinion, the primary reason that we must relate is to exchange information on program, course and research development. Each institution is searching

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for improved course syllabi, better methods of securing individual interdisciplinary faculty input, and procedures for interacting with other academic units served by the environmental studies program and vice versa. This exchange of successful and unsuccessful experiences in program development will help everyone and particularly the students. Of course, one's success may be another's failure, and we do not want all programs to be the same.

We need to know the faculty and courses offered at other institutions so that students may be given proper advice, either on the desirability of transferring to another school or on acceptance of course credits for admittance. When institutions are close to one another geographically, it may also be desirable to permit course enrollment at the other institution as a method of economically augmenting the study program.

Relating to other institutions will help in the research effort, not only in finding out what others are doing, but also in exchanging information, reducing duplication, and possibly in enhancing collaboration.

A pragmatic reason for relating is that we must know what other institutions are doing in the region so that the program can be defended adequately when questioned by the State Council on Higher Education and by institutional administrators.

In order to survive and gain support in this competitive society, it is necessary that environmental study programs be well recognized and achieve respectability. This can only be done through mutual cooperation and activity; witness what has been done in the case of the traditional disciplines and with the interdisciplinary programs in water resources and oceanography.

Some examples of successful institutional relating can be found in the: Univsities Council on Water Resources; the Association of Environmental Engineering Professors; the Washington Water Research Center; and the developing Washington State Archaeological Research Center and the Washington State Energy Research Center. In the Pacific Northwest we are in the early stages of forming a "Northwest Association for Environmental Studies", for the purpose of relating to one another on the topics just discussed.

This general symposium on environmental education is a good example of an effort to relate and I hope that it will be followed by others that will deal with specific segments of the task before us.

DISCUSSION

John Gustafson: The title of the panel we just had says, "How can institu--tions relate to each other in environmental education?" I began to listen because the Alliance for Environmental Education is a means by which not institutions, but organizations may relate to one another in environmental education.

Many of you, I'm sure, know of the Alliance. It was formulated about a year and a half ago. I'm now the president and Bob Cook, whom you have met and heard today, is the president-elect. The Alliance has about 28 organizations. I say "about" because there are one or two in the process of joining. These organizations are national in scope. They range from those that are very limited in their programs or in their aims in environmental education, like the Conservation Education Association and American Nature Studies Society, to those with broader interests, the National Education Association, National Wildlife Federation, Isaac Walton League, League of Women Voters. These are some of the kinds of organizations that are in the Alliance.

We are there together because we all have some interest in environmental education, and we want to share these limited resources we heard about today. Many, many of the things that were brought out in regard to institutional cooperation, also apply to organizational cooperation on the national level.

We have engaged the services of Jack Snell from Indiana as our part-time executive director. Hopefully, as the next few months go on we will find sufficient funding to make him a full time executive director. We are planning to have a national office in Washington. We have made arrangements already with the National Wildlife Federation for office space. We want to be in Washington because we feel this is the place to be in terms of influence on legislation, getting on the tail of some of the organizations in government which we're concerned with, and so on.

I want you to remember the Alliance, and to try to cooperate and enhance its action as much as possible. We're not yet ready to step out and become a real action organization in terms of workshops or doing things that cost a lot of money. We just don't have that at the moment, but hopefully, when these first organizational phases are over with, we can step out and really go to town on a

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Tom Offutt, of The Institute for Environmental Education, was the moderator for Session 3.

national scale in environmental education. So, I just thought I'd bring that little word to you, to welcome your interaction with us.

Question: We have some problems in our environmental science program. I wanted to voice these problems and maybe solve some of our difficulties.

First, our environmental science program is offered in the division of social science. We're very defensive because there is an accusation of a lack of science, a lack of rigor in such a program if it is spawned from a social science division. We would appreciate any help in a defensive rationalization.

Secondly, we do need help in curriculum development, not so much in development itself as in finding some ammunition to defend the curriculum that we have developed. I think we have fairly sensible ideas as to what an environmental social science curriculum should entail.

Thirdly, a credentials program. I was plea[illegible] to hear that Sanitary Engineering is now Environmental Engineering. I don't know why they changed their name. But I was pleased to hear that they did, and that they have an organization and possibly accrediting standards. Is there any movement in environmental education, hopefully nationally but even regionally in the Northwest or in the Pacific area toward accrediting or establishing standards for such a program so that we can say, "Yes, this is an environmentally trained person"?

Fourthly, Lewis and Clark is a regional college, and at the regional college level we do feel a definite need to relate to the institutions, especially the secondary institutions, in our area. I'm taken with the Wisconsin program, the University of Wisconsin at Green Bay. I would appreciate it if, when the University of Wisconsin does get its program written up and described, the description were made available to interested people. Also, I hope that the proceedings here will be made available as soon as possible before their funding runs out.

Answer: I don't know who wants to tackle that. I'm certainly not going to. I would say one thing: maybe words are important when you're trying to sell a program, and you're talking about where the social sciences and the sciences fit together, and these are just words, but I think it comes from having seen it happen. That is, if you can approach a problem that is real and meaningful in the community as a focus for an environmental education program, and the sciences are used to understand that problem and the social sciences to try to bring some effect and change, this is how they come together. But they have to come together, I feel, around a real problem and a problem that's seen by the students.

Question: I forgot the most important question, what I really came here for, the number one reason. I was asked to draft a pamphlet that would describe the program. But primarily it would describe job opportunities--this disgusting vocational orientation. I made several long distance phone calls. I called up the University of Washington and either they have no knowledge whatever of the job situation, or they've got something that they're not going to let out. In any event, they didn't help me. The University of Washington, of course, sponsored the symposium, and I came here hoping that there would be industry representatives who could spell out what they see as adequate undergraduate training in environmental science. I need some information, though--immediately--on job opportunities, say at the federal and state level--job descriptions.

Sylvester: I will try to respond to some of that. You called our university and asked about job opportunities? Sure, we can give you scads of them, it depends on what you're after. You have the philosophical problem, "Should a university be an institution for training people for specific jobs, or should it be primarily to educate people?" There's a big difference. We're trying to do, I think, both.

Secondly, the environmental field is just enormous. It almost defies definition. And every school cannot, should not in my estimation, try to be all things to all people in environmental affairs. You have certain strengths, we have certain strengths, we should capitalize on those.

Also, we have the philosophy that a student going through an undergraduate program, for example, should have a particular strength, be it in engineering, biology, economics, social studies, so that when he or she finishes, the student can have something to sell. They can say, "I really know something about this field", and in addition, then, they have picked up the environmental associations. Sometimes this involves a dual degree, and we have quite a few students who do that. For example, we just had a woman who got her degree in botany. She got a second degree in environmental studies. She'll have no problem, I'm sure, in getting a job.

We have others who study general interdisciplinary environmental studies, a smorgasbord. They want to do it. If the student wants to do that, God bless him, we'll help him pick out something. But if we have the chance to advise him, we'll advise him to develop a strength in a certain area. And as to accreditation, I think that it's way too early to even talk about the subject. You can argue accreditation around and around in circles. It can be stifling. The one thing that we do not want is to establish a curriculum that nation-wide is pushed as, "This is the way you should go on environmental studies from the science standpoint." This locks you into something and puts you in the same position many of our traditional discipline departments are in, where you have all these hoops to jump through, hurdles to go over, before you're called a zoologist or whatever it is. It's very narrow, we don't want that.

It's our impression that students should tailor their own programs at this stage of our development, and we'll help them and advise them and try to make each a good, strong program. But we do have to face reality. I think that, by and large, where we can we should turn out students that can fit into society and play a useful role. I think we can do that in many, many areas. You're wondering where they are. We do have in the program tomorrow some people talking from, you might say, the outside world, addressing this very subject.

As to curricula, I'm sure we would be happy to send you what we have, and so would the other people here; and I'm sure nearly all of the others also are at a very initial stage of development.

Question: On the subject of environmental careers, I conducted a brief survey, because I was making a talk in Washington to some high school students on environmental careers. So I called around in the state of Maryland to different people, and I found that Maryland hires between 100 to 200 people in the State Department of Natural Resources in a pretty wide range of jobs that run from an eighth grade education minimum to a master's in environmental planning. You could extrapolate that to other states, just in their departments of natural resources. That would probably give you a rough idea. I think that the jobs are really there, to a large extent. The problem is that you just don't know the magnitude. If you take the three broad categories of pollution control, resource management and environmental planning (which is everything else), I think you can say that there are probably going to be some tens of thousands of jobs, nationwide, in those areas in the next five years.

Sylvester: I think I could respond directly to what you're trying to do, perhaps. Some ten, twelve years ago I started a program in Water and Air Resources, (including solid waste and so forth) at the University, into which we admitted--this was a graduate program--all categories of engineers, chemists, biologists, and to a lesser extent, some social scientists and some planners. Our attempt was not to turn out everybody as an engineer, but to turn out the biologist that is a better biologist, one that can work in a team effort, who understands the expertise of the other people he has to work with, and how they can cooperate. We've had roughly a hundred or more students each year in this program. We can't begin to supply the requests for all these different types of people. It has an interdisciplinary faculty and it is housed in one department, which we are not now trying to do in our environmental studies program at the University of Washington.

In my program in environmental studies I have to answer to eleven deans, those most concerned with environmental matters. I envision that as our program grows we'll have all sorts of pathways for the student. Each student that goes down a particular pathway, say it's environmental aspects of energy, each one of those students who chooses this pathway, and I'm sure that we could get all sorts of them hired with the federal energy office, will have really a different program. It will be similar but it will be tailored to that student's previous background, and perhaps what the student wants to do when he or she finishes school.

Comment: I think I have an obligation to comment on the comments of my colleague. I'm from the Environmental Protection Agency. I think he may have exaggerated, or painted a too optimistic picture about employment opportunities that broadly deal with environmental protection, including pollution control, environmental planning and resource management. I can't speak for environmental planning, whatever that might be, which involves, I suppose, planners for community development. But in the area of pollution control, from the studies that I have been able to see and from the discussions I've had with state and local officials, and in the private sector, I think that if there's an expansion in the work force, it's going to be in the engineering and technological areas and not in the social science areas. Looking around, for example, at the state agencies, just take one area. There are about 5,000 people employed in the state and local air pollution control programs. The most recent data we have indicates that there's not going to be a great deal of expansion, because there simply isn't the increased budget. Those positions that are being recruited for, are almost exclusively engineering and technological positions.

Answer: These engineers that you hire for air pollution need to be engineers that are more than engineers that add, subtract and divide and go down a narrow technological path. They need to see how air pollution problems relate to problems of society, the political, the social, and all that we've been talking about, so that there's something more than just an air pollution engineer or air pollution chemist.

Question: Well, all I'm saying is that the basic educational preparation in engineering or one of the allied technological fields, or in science, is, in my opinion, necessary. It may not be sufficient credentials for a job, but I think you'll find that in most cases it's a necessary credential.

Answer: Yes, as a specialty. But wouldn't you prefer to hire somebody who has this extra environmental training?

Question: Indeed, sure.

Answer: I would hope that we don't get caught in the linear thinking trap--where, if you're a chemistry major you automatically end up in chemistry, or if an English major, you automatically end up in English, because this is not the case. That's not the way things move in undergraduate education. At least, what I've been arguing for here today has been an enlarged and perhaps a modified view of the relationship between the humanities and natural science in terms of an environmental education package. And I think that these people are going to find their way into just as many and diverse niches in our society as people who come out with a degree in English, people who come out with a degree in history, and who don't go on in English or in history. But they're going to come out, I think, with an awareness of the circumstances that confront us today that are much, much more realistic. And to make a case in point here on the non-linear nature of professional life, I rode on a plane with a vice-president of Foss Tug, one of the big operations here on the West Coast. What was his preparation? He was headed for the Jesuit priesthood. He felt that his degree in medieval history had really prepared him for the vice-presidency of Foss Tug.

About a year and a half ago, we were asking the same question about job opportunities of the regional director of the Department of Ecology here in Washington. "What do you want?" and he said, "We're not hiring people who come from environmental studies programs. We're hiring sanitary engineers." "What do you do with your sanitary engineers?" "Well, we have five categories that we call environmental scientists, and we reclassify them according to their experience." We're talking about practicality. No matter what they call these guys, they're still their sanitary engineers.

Question: Can you see possibly an advantage to definitions or, harking back, to accreditation of the environmental scientist? I myself know the situation. You have to have a degree, a technical degree. I know that, I knew that all along. So I'm pleading for help for rationalizations to defend our particular course. We are exercising a dual major too, a major in botany, a major in environmental social science. But we're having environmental scientists forced on us. I think this has come out--they are not environmental scientists, they are technicians, they are narrow-vision people. I would hope that out of the proceedings of a symposium like this, we might come up with an expression of a need for new orientation, new directions in problem solving and maybe we can help the environmental social scientist in the job market too.

Answer: Well, I know Bob Sylvester's interest in getting an organization going. You will not get accreditation until you get an organization that can accredit. We don't have such an organization. It may be that one of the things he's shooting at here today with this particular program is, "What can we do in order to pull ourselves together so we can use our common resources in developing this thing?"

Bartuska: I have just a few random comments to this collage of questions. At the M.S. level, our most popular area of specialization is in the engineering sciences, and those are automatic employments. And I think the employers really appreciate a broad background, plus an area of specialization. The students who have this broad background present themselves in a more exciting way to the employer. I think this is true. They have some sort of inner comprehension which is very important.

The other thing that I would like to relate to is curriculum development. I would suggest taking your problem to your faculty. And if you can't generate a curriculum or an emphasis among your faculty, maybe you shouldn't have a program because it's there at the grass-roots level that it will evolve.

Question: Students too?

Answer: Of course, students.

Comment: First of all, I'm getting the impression that we're discussing problem solving as something new and recently discovered since the invention of something called environmental studies. I think that we need to acknowledge that there is a history of problem solving. It's not really new to education. That is a system for educating that's been around for some time.

Secondly, one of the things that also impressed me was the fact that we're rejecting the idea of standards. I don't understand how we can talk about having any kind of credibility without having any basis or any standards. And that ties in with my third statement, which is that we're telling students to come and work for us, or come to school and we'll find you a job with the environment. Then we're saying, "Well, we really can't give you employment in the environment, but you can go and work for a business or you can go to work for somebody else, just like all the history majors did, and all the English majors did", and at the same time we're saying that the history and the English departments are losing students, and we want to build up our environmental studies department.

Somehow those issues need to be resolved, and I'm not sure we're addressing those issues. All we seem to be saying is the same kinds of things we've been saying for some time. Let's just talk about problem solving and whether students know how to solve problems. Somehow, most of them are going to develop jobs and solve the problems of society. And I don't think we're attacking the problem before us.

Answer: We need to try to define the difference between being trained and being educated. About three or four years ago it finally became clear to me what the difference probably is, and now I'm positive of it. I find that if you have a job, you're trained, and if you're unemployed, you're educated. This really is quite serious. I'm not sure if we understand the implications of it, and what it means all the way down the line in education. Because I think all of us are really looking for people who are educated and trained at the same time; we're using the terms as the same.

But because of different needs to do different things, we find that we can draw the line at different levels. We can draw the line after two years, and we have someone who can go to work doing certain things. We can draw the line after a month and give him a diploma or a certificate of attendance and he can go to work. Or we can draw the line after eight years or twelve years of study and call him a Ph.D. geneticist or a Ph.D. environmental engineer or an M.D., or what have you. But still in the long run, what we have really done is to train these people to go to work. It's just that it might take a little longer to do it, or the line is drawn at a different point. But that, to me, seems to be the only difference.

Now, this reverts back to the things that were said earlier about the role of the two-year college in training, and on to the four-year college and so on. The two-year college does have to and will train people to actually go to work. But they still have the responsibility to educate or train people who can then go on to the four-year unit, who can then go on to graduate school. In order to do this, we have to not only set standards but we have to define what we're talking about. We have to sit down and say, "What are these people?" So to define them we have to find out what really are the needs. And you can't do that in this room here. You have to sit down with government, you have to sit down with small municipalities, and you have to find out what kinds of people they want for these particular kinds of positions. And yes, they may very well want an engineer, as well as someone who has a basic degree--I like to think of him as a biologist with a minor in engineering. But that's just because of my own bent. Nevertheless, you still have to find out exactly what these people are needed to be. Then you can define what they can be doing. When you're doing this definition, you can then set the standards higher. None of these things can happen by themselves, and none of these things can happen without a recognition of what the needs really are. We can't resolve that just sitting here and throwing terms back and forth. It takes much more work than that.

Answer: I'd like to respond to the question on accreditation. The kind of accreditation I don't think we're ready for or should have is like what there is in engineering. In a traditional program you've got to have so many units of humanistic social studies, so many units of math, one year of physics--it's all structured and locked in. If we had accreditation teams that went around and looked at the quality of the faculty in the program, the quality of the courses, whether the courses add up to some coherent thing, has the student really had a good experience--if we look at it that way, I'll buy it. The other is too restrictive. It stifles the imagination, and our whole environmental studies movement is nontraditional. It's innovative, experimental, every one of us here is trying a different program, really. I'd hate to be on a board to accredit them based on one set of standards.

Comment: I think it should come, though. It's a guarantee that a man who works in an environmental position, it promises his employer that he has the vision to see beyond his specialty, and that that vision is guaranteed by some academic curricula he has undergone. That is the way we're going to save the field. Otherwise the field is just going to be a dilettante field like English. Environmental education is just going to be a nice experiment unless we do define it.

Offutt: As moderator I shouldn't say anything, but I have to because I've spent most of my working career recruiting and training for industry, and I have some rather strong feelings. I don't think you can say that you want an environmental generalist to be such a thing. In every industry and every organization, every person that is hired for a job is hired for a different reason and a different purpose, and you may want an extremely narrow individual with no scope, no vision, no nothing, to sit and do a specific job. I hope that we don't have to come up with Leonardo da Vincis for every program in the country, and I don't think that industry would want us to.

Comment: We're doing injustice to the whole environmental studies thing by making employment a criterion for its validity. If you look at who the employers are--big industry and the major forces that have the money in this society--that's not who I want to work for. In fact, if I were working for them, I might begin to wonder if I'm doing the right thing. I'm purposely training myself for something nobody wants, or at least what very few people want. Certainly, no one's going to pay for it, and no one is going to pay for shutting down polluting factories. There's another whole sphere of persons, they're not dilettantes, they're not people who sit in an esoteric circle talking about environmental science, whatever that is. This person is an activist, a grass-roots organizer or a community organizer, and he's very expert in a lot of different things. He knows what he's talking about. I may have to work washing dishes, but my real job is something else.

Answer: The student does have some responsibility. The academic people may like to think that they're creating their graduates out of silly putty, but students can make decisions, and what we need perhaps is information about jobs available at the present state. And I realize that his may not help with freshmen making their decisions because things really change fast. But there are people who do long-range projections, and somebody made the comment about academic institutions creating and certifying people as having vision, I don't know if you guys can do that. I think we have a responsibility, but I'm not sure that's what it is.

Question: It seems to me that all the panel members simply listed instances of institutional cooperation. I was really disappointed that there was not more analysis of the costs, as well as the gains. Every instance that I've been involved in, quite a wide range of them in the educated world, all failed dismally. It took all of our energy to maintain our interface, and we never got anything done. But with that as a bias, I wonder if we could ask the panel members to comment on some of the kinds of circumstances or problems that inter-institutional cooperation seems to work with, and some of the areas where even the attempt might be disastrous.

Kennedy: To give an example, the state of Washington is attempting to work with state agencies to develop policy in environmental education in those agencies that can support it in a legitimate fashion. My comment earlier about bootlegging came from that one, because they all do it. They don't have a policy. We're looking at a bunch of individuals from various agencies that have a real, keen feel for this thing. And when they die, or when they go, or when they're transferred someplace, the feel goes with them. There's nothing left. I think this is a real problem with these kinds of relationships. Therefore, I want to get back into policy so that the people who come along next have a basis to work against, or from. And so the people at the top level of management who have to make decisions and commit resources have a basis other than that some fellow down there had a good feeling about it a few years ago.

We're looking at a study that we have undertaken over the last year and a half. I can give you an exact dollar figure on that. Just for the development of the rationale for such a policy, the hard actual dollar figures are about $21,000 of grant money. The rest were "in kind" services. We've kept very accurate records with time. Eight agencies, about a year and a half, one person from each agency interacting with each other, about $21,000. Is that what you're looking for?

Question: I'd like you to comment on whether that's a good idea. If you'd given each of the agencies $3,000, they would have gotten a lot more done.

Kennedy: That possibility exists. We chose this method, and at this point I'd say that we're half done. We've convinced some people at various levels within these organizations that this is a pretty fine way to relate to each other. We have yet to convince the people at the top who actually have to make decisions, who actually have to implement policy, and make policy, that it is a good idea. So, I don't know yet. Maybe giving them $3,000 and letting them go on their own separate ways would have been a better idea or maybe not. Probably in six months we will be able to tell. I have a good feeling about what's going to happen as a result of it. We're legitimizing things so that people can legitimately commit manpower and resources and materials to support programs in environmental education at every level. We're not looking just at the common schools although that's what I represent, K through 12. The missions of the individual agencies don't include K through 12, for the most part. They include the broad, general public. So somewhere, all of this has to fit together, the policy that is made has to be broad enough to include their total responsibility, the total population they're responsible for, not just the one I'm concerned with. We've got to dovetail and fit the pieces together. I don't think any of those eight agencies could do that all by themselves. I just don't think that could happen.

Comment: One of the big problems is whether or not we all recognize there's a need for this kind of cooperation. Several years ago I worked with a group from Eastern, that was discussing the potential for a cooperative program in nursing education. There was a need. The hospitals were pulling out. What were we going to do then? The health services were making demands for increasing the numbers of nurses. It looked as if, particularly in this area, there was going to be a decrease. Today there is an active program. It's still cooperative. Washington State University, my institution, Eastern, and two of the parochial schools in this area have cooperated. They formed a body that has existed through a lot of squabbles. First there was a need, they formed a structure, the structure was there and they were able to continue. This morning there was an attempt, I understand, to bring together a major environmental group to develop a foundation that would provide the impetus for cooperation in the environmental field in this area. I understand that the deck of cards has fallen, and I could have predicted this. The thing we have to do first is to develop some kind of program on which we can agree, and then it will be possible to move ahead. I'm sure this cooperation can be developed, but people have to agree to do it.

ENVIRONMENTAL EDUCATION: A POLITICAL VIEW

Tom Foley

The subject for this morning's discussion, "A Political View of Environmental Education," is one with which I'm going to take a few liberties. I'd like to discuss in a broader context, if I may, some of the political impacts that I foresee occurring in the coming months with respect to general questions of environmental policy.

The United States did not involve itself in environmental legislation, probably with the exception of the Refuse Act of 1899, until the middle of the 1960s, when environmental concerns became a topic of active discussion publicly and the subject of legislation in the Congress. We began to witness the arrival of air quality acts, water quality acts, and other major environmental legislative efforts in the late '60s and early '70s. Congress sometimes is accused of operating at the whim of fashion, and every committee in Congress that had a possible connection with an environmental jurisdiction seemed in a rush to find a way to emphasize its own concern with protecting the environment. As environmental programs were developed in all the agencies, environmental appropriations rose dramatically. In general, the subject became about as popular as the famous motherhood and the flag. No one would criticize environmental legislation. It generally passed by votes of, in the Senate, 82 or 85 to 0, or in the House, of 378 to 12, apparently indicating a national consensus.

One of the acts that passed in the early '70s was the Environmental Education Act, whose purpose was to increase public awareness of environmental issues while trying to develop an extended, persistent interest on the part of the general public in both the protection of the environment and the critical decisions that would have to be made about it. In addition, it was intended as a means to separate fact from fiction about environmental issues, to enable the public to make informed decisions, to give needed perspectives in the various areas of controversy that might arise, and to help plan for the future. Among the things for

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Tom Foley is now serving his fifth term as a member of the U.S. House of Representatives from the Fifth District of Washington. He was elected Chairman of the Agriculture Committee in early 1975.

which the Act provided were the creation of an advisory council to develop programs and curricula at the various levels of public education as well as in the other areas of jurisdiction covered by the bill, to develop communications education policies, and to assist state and local agencies in establishing their own education programs for primary and secondary schools and in the preparation and distribution of materials for use by the mass media.

The act was not adequately funded during its first few years of existence, and indeed, was not given a fair chance to show its potential. At the beginning of the present Congress, the 93rd, legislation was introduced to extend the act; and authorized funding was finally agreed upon this year, allowing $5 million for the fiscal year of 1975, $10 million for the fiscal year of 1976, and $15 million for the fiscal year of 1977. The programs are on a cost-sharing basis with the exception of the civic action programs.

The extension of the bill includes the authority to discuss costs of environmental protection. As I see it, we are now moving into a period when, although the consensus supports protection of the environment, the area of implementation of programs and regulations will become increasingly controversial.

It reminds me of a story about the Congressman who got a letter asking him what he thought about the subject of whiskey. And he said:

> I've always answered every question straightforwardly and honestly. I'll answer this one just as candidly as I always do. Madam. You've asked me what I think about whiskey. If, when you speak of whiskey you mean the devil's brew, Satan's potion, that evil substance that has driven more Christian men and women from the heights of propriety and godliness to the depths of sin and desperation and despair, that's broken up more households, ruined more families, set more orphans into a long period of confinement and loneliness, if you mean that substance that's wrecked the economy and wasted more energy and resources than any other in our history, then I'm against it with all my power.
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> But if, when you speak of whiskey, you mean the elixir of life, the spring of conservation, which puts spring in the old man's step on a frosty morning, the substance that allows hard-working men and women to forget, even for a moment, the cares and tribulations of the day, that subject, the sale of which has poured into our public treasury untold millions of dollars for the education of children, for the relief of cripples and orphans, for the erection of great institutions of science and research, I am for it. And I will not compromise!

I'm afraid we're going to have some letters like that about the environment. If, when we speak of environmental protection, we mean making the rivers, lakes, and streams of our nation pure, safe, and sweet for swimming, fishing, and recreation; if we mean making the air fit to breathe, ending the poison and disease of air pollution, removing the ugliness of solid waste, then everyone is for it.

If, however, we talk about increasing the appropriation for solid waste disposal, providing regulations on water quality or air control that may have impacts on the economy, or costs to the economy or private industry, then support will not be as ready. In all these decisions, the public is going to be barraged with conflicting statements, arguments, and disputes, as well as with varying combinations of data. An example is the recent full-page ads by the American Power Institute challenging the Environmental Protection Agency's statements on coal burning.

The issues are going to be brought more and more into the political arena in Congress, in legislatures, and in general public discussion. There will be, I think, an increasing need to provide the public a set of basic tools with which to analyze the conflicting statements and data so that it may respond. Essentially, these are decisions requiring a large degree of public involvement. After all, the society is going to be making decisions as to whether or not we must accept such trade-offs as, perhaps, enduring greater noise levels in favor of the theoretical saving of some cost in the production and distribution of goods, or vice versa. We're not going to be able to make those decisions without public impact and controversy because it is already clear that the arguments are being drawn and the forces are being arranged. I was a delegate to the so-called "mini-convention" or "mini-summit" on inflation in Chicago and another major one in Washington. The message at these meetings was very clear that there is a certain segment in industry which argues that, in the face of inflation, now is the time to move away from environmental, health, and safety legislation. In my opinion this is not a view supported by the majority. Yet, a small minority may attempt to use inflation as a lever for wiping out all environmental health and safety laws.

For example, we are told that controls reducing noise pollution to 85 decibels would cost industry $31 billion. Now whether that's true or not is a matter which will have to be examined and a decision will have to be made as to whether these costs are extreme, or whether other alternatives can be developed. I am afraid that if we are not careful what will occur is a confrontational approach in the environmental field which may stultify effective action in almost any direction.

We are, I fear, going to hear the argument made on the other side of the economy too, an argument that we have to drop environmental laws in order to stimulate the economy due to the danger of recession. We're moving into what I think may be a recession as deep as the '58 recession at the end of the Korean War.

So the society will be required to make a lot of decisions. Politicization of environmental questions has already come on rapidly, and it will continue. Questions of the environment and its protection are relatively easy politically in times of high output and high prosperity, where people have a great deal of discretionary income, where there isn't any great inflationary problem and prices are stable. People are happy to support environmental proposals, environmental regulations and environmental expenditures. Yet if they think the economy will be affected either in an inflationary or deflationary way due to the cutback in growth and activity, then environmental protection becomes controversial. When this situation occurs, it is not the environment which is attacked but the environmentalists who, in this context, are defined as people who want to protect the environment in an improper, inappropriate, or too expensive way.

We have spent most of the last year in the Interior Committee, on which I serve, on three bills: Surface Mining, Land Use, and Energy Research. The Land Use bill became so controversial that we were unable to obtain a rule in order to debate it on the House floor. The Surface Mining bill went through months and months of hearings, long delays on the markup of the bill, and is still in conference with the Senate. There is some doubt that it will be passed at all by the end of this year.

Increasingly, these environmental issues in the Congress that used to whip through with little or no problem are bogging down in committees with some of the bitterest and most exacerbated and extended legislative battles that I've seen. There does not appear to be much enthusiasm in Congress, at least in the Interior Committee, for renewing the fight over the Land Use bill for another 10 or 11 months, only to have a huge national emotional confrontation and to find that once again it will not be debated on the floor. It's taking an enormous amount of time to resolve these issues in Congress because they have not been decided by the public. Furthermore, there are many popular misconceptions which surround this legislation. People are being told that the Land Use bill will take control over their private land, that they won't be able to receive compensation if the government takes their property, and so on. A lot of nonsense is said about the Land Use bill; but because it has been said with some effect, land use has become an emotional issue.

With respect to surface mining, we're told that the bill cannot operate effectively while at the same time permitting the mining of coal, so that the energy resources we need will be unavailable if this bill is passed.

I think in all of this increasing sensitivity and controversy over environmental legislation and its impact on the energy crisis and the economy, we're going to need a higher and more general level of public discussion and awareness. It is my hope that the Environmental Education Act can make a modest contribution in that direction. I think, too, that from a political standpoint, the discussion has to be on a little broader level in the sense that all the various elements of the community must become involved. Environmental protection tends to be a somewhat elitist subject involving primarily people who already are concerned, university educated, articulate, and inclined to associate with one another in various community activities. I recently spoke at the Brookings Institution on the subject of food aid and was told by one of the Overseas Development Council representatives that everybody in the United States was for extended, additional foreign aid and food assistance to countries that were starving. They inferred this on the basis of a long series of discussions conducted throughout the country. My own reaction is that they could not have talked with many people outside of groups especially concerned about this subject. Quite frankly, as a political individual, I have not found a great outpouring of demand among the general public for more foreign aid. Quite the contrary, I think it's going to be difficult to persuade Americans that they should do their humanitarian duty towards countries that are near starvation. Yet, after talking to very specifically concerned organizations such as church and other civic-minded groups, who had already taken positions on this question, the Overseas Development Council team felt that everybody in the country was for it. I think, in other words, that sometimes the question of environmental policies is a harder issue, in union halls as well as in board rooms, where the primary concern is on the economy. Often the issues of environmental protection and regulation receive their harshest criticism from those involved in the economic process. As an example, farmers are terribly upset and sensitive about what they regard as the pending intrusion of environmental protection into farm activities, particularly into water quality standards. I think, to be frank, that for those who are concerned about environmental protection, who are devoted and committed to it, some greater political sensitivity is perhaps going to be needed, because increasingly the environmental issue is being framed as an economically disruptive and damaging issue for people. A survey taken in Eastern Washington a couple of years ago indicated that there was a marked drop in concern about the environment in this part of the state as compared with the west side. That may be because we have a little more open space; but also, I think it is because many of the areas here are still sensitive about economic development. Further, they've begun to associate environment as a restraint on economic development.

The Congress is no longer to be counted on 100 percent for support in the area of environmental legislation. There is a rising tide of resistance to standards initiated by Congress that are considered too tight, too restrictive. This has afforded the courts an opportunity to enter the field by pointing out strict Congressional standards that have not been met. Thus, it leaves the door open for more flexible administration of the environmental laws. As you probably know, Congress has passed legislation extending the time for the air quality standards to be met by the automobile manufacturers to 1977. They've also passed legislation allowing the emergency burning of certain high sulphur coals in case of fuel emergencies. It appears possible that we may have such an emergency this winter, particularly if there is a coal strike.

In general, there is a willingness now to breach some of the environmental protection acts if it's argued that this is necessary for either inflation control or allocation of critical materials, such as fuel, which are in short supply. The problem, again, will be holding the line against those who want to move forward beyond argued immediate emergencies and try to dismantle the legislative framework of the last 10 years which has committed this society to environmental protection and improvement.

DISCUSSION

Question: You said that it didn't look like the strip mining bill would get through Congress. Everything I've read indicates that the President would veto it anyway.

Foley: There are consistent suggestions that he will. It probably depends on what the conferees agree to. If the Administration were satisfied on some of its objections, he might not, but some of them go beyond the conferees' authority, because some of the things they objected to are in both the Senate and the House bill.

Eastern Washington is not an area where there's surface mining. Some of our power, however, is generated from a place in Chehalis that strip mines. But it's a major problem in Montana, Wyoming, Colorado, in that part of the intermountain West where huge deposits of coal exist, and where there is most of the fear that we're going to have a serious reclamation problem if we don't have adequate legislation. I didn't predict that the conferees wouldn't reach a conclusion, but I think it's an open question.

Question: What is going to be done about recycling?

Foley: Recycling is still, unfortunately, a very, very small part of our industrial output. I would hope that we could see greater and greater efforts in that direction. There's some hope, for example, that a company has recently developed a way to get petroleum out of used automobile tires, which are a solid waste horror. They can't be burned, they can't be compacted very well. If a system can be developed to make that feasible it will be a major step forward. Recycling of municipal waste has shown promise in some parts of the country. As the state of the art improves, it's alleged that a good part of the cost of solid waste treatment might be picked up in recovering materials and generating power. But again, we don't have programs to provide much additional assistance to encourage communities to develop plants to recycle solid waste.

Julia Stuart of Spokane, member of the National Advisory Board Council, U.S. Bureau of Land Management, moderated Session 4.

Question: You mentioned a more elemental approach to environmental education or environmental awareness than this upper-level type of discussion. What would that more general approach be?

Foley: I'm thinking about an effort to reach groups and individuals and organizations that might not normally consider environmental questions or problems. There is a core of organizations and individuals in this society that are already highly motivated and concerned about the environment: conservation groups, various kinds of environmental protection organizations, the League of Women Voters and others.

But the political impact is going to come from a much broader segment of the society, what's said about the environment not only in board rooms but in labor union halls. How they feel about environmental protection is going to have something to do with the programs that are going to be developed and carried out. There's a tendency for those who are more aware and involved not to talk broadly enough with other groups and individuals. If you ignore a great part of those who are actively involved in the economic impacts of the decision, politically it's not very wise.

Question: You indicated that economic concerns such as inflation have delayed or reversed some environmental legislation. I just wondered if this isn't a matter of whose ox is being gored.

Foley: The near panic about inflation has encouraged everybody who has any other goal in society to try to connect inflation with their objects of opposition, whether it's somebody who wants to tighten up on oil companies or somebody who wants to tighten up on environmental regulations, or relax them or whatever. I hope I'm not misunderstood, but inflation control is going to replace patriotism, I'm afraid, as the last refuge of certain types of people. Some want to attack labor productivity or lack of it as an ostensible cause of inflation, so we should do away with labor unions, do away with the minimum wage. If you want to attack from the other side, tighten up on the antitrust laws, break up the multinational corporations, and so on. One of the most troubling problems about the whole inflation crisis is the need to fight everybody who wants to use inflation for other purposes, including the repeal of health, safety and environmental acts.

On the other hand, there is a legitimate question about how much these things cost, in appropriations and in the economy. But they have to be weighed against what it costs not to protect, whether it's public health or whether it's various kinds of other social and economic consequences. There is a lot of talk about doing away with occupational health and safety laws. Those accidents and injuries cause a lot of economic loss, too.

Question: What do you see happening with the Land Use Planning Act?

Foley: The federal issue arose over whether we are going to have a good bill to provide federal funds, matching funds to the states for state land use planning. The bill did not, as you know, involve any kind of direct federal control over land use. It involved federal support to the states if they wanted to develop land use programs, and what the state land use program was, was really left totally up to the state. It was a planning process that they had to start -- not anything, frankly, like some of the rhetoric and other information or misinformation that was spread about the bill.

The results were that we just couldn't even get up for a debate, people had gotten so excited about it. It had become so controversial. So we have the problem that we're not able now to identify in advance in most states where transmission lines, power plants, various kinds of key facilities are going to be located, when those facilities are needed. There are sometimes long controversies over where they should be placed. The studies that otherwise could have been done earlier about impacts can't be made quickly enough to satisfy what others in the society say is an immediate need. The old machinery of land planning only on the basis of local communities really doesn't meet the needs in highly urbanized areas where different municipal organizations abut each other. There needs to be greater cooperation.

I think land use planning is going to come. I just think that probably we're not going to get the federal financial support to states that would otherwise have occurred if this bill passed. I'm doubtful, unless things change, that we're going to see a bill passed in the Congress.

Question: Speaking of environmental education and the general policy of reduction of federal funds for education, I think the time following kindergarten is most crucial. What are your views for the future of these programs and what might be done?

Foley: "What is the future of these programs?" is a difficult question to answer because, again, I'm afraid we're going to see great pressures brought to bear to eliminate many, many programs on the federal level in the name of fiscal restraint. It's a serious problem. We've indicated a goal of $300 billion in spending. If the economy continues to slip, government revenues slip with that, and government expenditures go up in public costs of unemployment compensation, various other kinds of economic programs, public works and so on that are sometimes used in the face of recessions. So we may get a very close pencil going over all the programs in the education and social welfare fields, as well as in military programs and foreign aid.

So much of the budget now, of course, is non-discretionary spending. You have $65 billion in social security payments, $35 billion in military retirement pay. You've got $23 billion in debt service, and those things aren't easily changed. Veteran's benefits, social security benefits, medicaid and medicare are fixed costs, so the tendency of the budget people both in the House and the Senate and in the Office of Management and Budget is going to be to go over these programs. And as you know, the Administration did not recommend that this program be continued. It recommended against its being continued. And there will be many, many efforts made with respect to other programs. So that if the program doesn't develop a little more effectively, I think, than it was able to do in its first three years, it may not survive. But I think that these issues are so keyed to the future of this society that some input in an effort to try to have intelligent public discussion of the issues is an important investment on the part of the government.

Question: I would like to know, can we clearly identify the costs of inflation in the environment, in housing, in energy? The second question is, we don't know what the real costs are of having or not having environmental regulations, and if we relax some of these things in the short run, do we have any idea of the public costs we might pay in the long run, for example, because of health effects due to respiratory diseases?

Foley: I wish I could answer the first question. If I could tell you with any certainty what the causes of inflation were, I'd resign my seat in Congress and make a great fortune in private consultation.

Environmental impacts on inflation have been argued to be less than one percent. Some go a little higher and say 1½ percent. But we are also, as you suggest, trading off other costs, other social costs, whether it's respiratory disease or, particularly, the recent problem with drinking water. About 15 percent of the samples tested by the Public Health Service recently in community drinking water systems were beneath minimum standards. Nobody wants to argue about the cost of drinking water in the United States, I think. There's a very high public interest in that, because it's an immediately and easily seen value. But it isn't as easily seen with the cost of respiratory diseases. Emphysema and other respiratory diseases have risen 20 times in the last two generations in the United States because of industrial output as well as smoking. This is part of what we should consider, and I think we ought to discuss it openly if we can get the data. The data sometimes is a little hard to find, data that we can agree on, anyway.

Question: I appreciate your remarks on safe drinking water, and I appreciate the fact that more than 15 percent is below standard. How come Congress hasn't passed a safe drinking water bill?

Foley: Because I think people have not yet realized that there is a problem. When they do, there's not going to be any question but that Congress will pass it.

Question: One of the things that bothers me as a citizen who has testified before Congressional committees in Washington is, when is it time for us to stop suggesting changes in bills and say, "We'll take 90 percent of what we want, and take 10 percent of what we don't want along with it?"

Foley: That's always an approximate judgment, and it's hard to give you a general answer. I would increasingly be taking 90 percent of what you want. The days have passed where environmental legislation can get 100 percent of what it wants very easily.

Question: Congressman, you mentioned special interest groups; I believe you're talking to a special interest group here today. Can't we have more funds for public education over the media, say debate teams giving the pros and cons on many points of our trade-offs in the environment? I'm getting tired of having Mobil and Exxon telling me how good they are for the environment.

Foley: Certainly on the local level that's one of the things that might be developed, some public service time broadcasting on some of the environmental issues. Radio and television stations are willing, and some of them eager, to provide the time. I think, also, we have to reach out to existing organizations and have discussions and debates generated about environmental problems, because I'm afraid that there is increasing possibility of a real myth developing. That is, that environmental protection and, broadly speaking, all health and safety regulations are one of the prime causes of inflation. Or it will be argued if we have a recession that they are one of the elements that has to be put aside in the interest of greater productivity and efficiency, that they just can't be tolerated in a period of economic difficulty or economic instability. When we get back to those balmy days of price stability and high profit levels and so on, then we can go back to protecting the environment.

We're going to have to insist on getting the debate before the public and getting the facts before the public, because it's a growing attitude. Many people are extremely impatient today with catalytic converters on cars, with safety controls and regulations. Sometimes there are stories told that simply aren't true. Senator Curtis went down, I'm told, and raised all kinds of Cain in the Department of Labor a few years back about the Occupational Health and Safety inspectors that were driving the farmers out of their minds in Nebraska with their absolutely impossible regulations. And the Labor Department said, "Senator, we don't have any OHSA inspectors in Nebraska inspecting farms." But farmers had told other farmers about it, and everybody knew the horror story that had happened in the next county. And the word went all over, and people are starting to develop a consensus about the restrictions of environmental health and safety laws that are simply based on myth in terms of both cost and restraints. We're not getting a balanced discussion of the questions anymore, that's why I think we need more discussions.

Question: A lot of groups are concerned that the political response to the environment has been one of cleaning up instead of getting at our use of resources. Do you really believe that we can become self-sufficient in energy in the next 10 years?

Foley: No, I don't think we can become self-sufficient in energy in the next 10 years. I think we can become more self-sufficient but not self-sufficient. I'm not sure that we really want to pay the cost of it. We might, theoretically, be able to get to self-sufficiency with horrendous costs, both to the environment and economically, and with severe restraints on use. But I think there is a need for developing efforts to become less dependent. We already are approaching 40 percent dependency on imported oil. Now that's too high. I don't see that we're going to get down to zero dependency, but we should certainly be able to get to much more manageable than 40 percent and growing. Alternative energy sources can perhaps be developed within the 10-year period to reduce that dramatically.

I don't think we can get to zero discharge either. And I think, frankly, that in some of these standards we're probably going to have to accept a more moderate goal. It doesn't work well to set standards that are so high that the frustration of not achieving them disappoints everybody involved.

TRENDS IN ENVIRONMENTAL EDUCATION IN MEDICINE

John T. Wilson, Jr., M. D.

I have been asked to talk about medical education and the influence that increasing knowledge of the environment will have upon it. My perspective of this is still being formed despite the fact that I have been involved in various aspects of environmental health, air pollution and occupational health for over 20 years. This involvement includes teaching at three medical schools and two schools of public health. Having said this, I must confess that I am not happy with the present situation. Were it not for the increasing student interest in environmental affairs, I think we would be in a sorry state. Let me tell you what I mean.

The knowledge explosion in medicine has paralleled that found in science and other fields of human endeavor. Most of us here understand that the things that we know today will not be true four or five years from now, and that new knowledge must be gained. However, it is useful to have a look at the past in order to develop a perspective on the current situation.

Since Hippocrates, physicians and other medical scientists have been concerned with the environment and its relationship to health. Hippocrates in his treatise, Airs, Waters and Places (1), discussed the balance between living organisms and the environment and indicated that sickness was due to a disturbance of this equilibrium. Naturally, he prescribed a regimen of diet, exercise and personal habit development which was intended to help reestablish the equilibrium. Despite the fact that most humans spend one-third or more of their lives at some occupation and are often exposed to various hazards in the conduct of their work, Hippocrates ignored the occupational environment in his discourses. To use the current student vernacular, Hippocrates seemed to have adopted an elitist attitude in developing his theories and totally avoided the working man, who was relegated to the lower classes.

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Alan Drengson of the Environmental Studies Steering Committee, University of Victoria, British Columbia, moderated Session 5.

Strangely enough, it was not until well over 2,000 years had elapsed before this fault in medical thinking was partially corrected. This was done by the father of occupational medicine Bernardino Ramazzini, who suggested to physicians that when talking with patients they should always ask the question, "What is your occupation?" (2) The answer to this question opened up the field for discovery of the relationships between occupational exposures and illness. Over the next two centuries the germ theory of disease was developed, and subsequently more scientific evaluations of the relationship between the living organism and its environment were possible.

For example, within this same period it became clear that the mal aria or bad air that had been described by Hippocrates actually came from mosquitos infested with a parasite later called the malaria organism. Physical factors and chemical agents were discovered to be more involved in disease production than had previously been suspected, but the preventive possibilities associated with control or removal of these agents from the environment were not sufficiently recognized. In fact, until the studies launched by Dr. Alice Hamilton at Harvard in the 1920's, it could well be said that the science of industrial hygiene or control of the working environment did not exist in the United States. The very recent discovery of the relationship between certain types of cancer and asbestos exposure, as well as a similar relationship between a rare type of liver cancer and exposure to vinyl chloride, serve as extreme examples of the lack of knowledge which pervades today.

ENVIRONMENTAL EDUCATION IN MEDICINE

The teaching of environmental health in today's medical schools is fraught with many problems. In my view, most of these problems are related to the fact that this subject area is taught by departments of environmental health or preventive medicine which have had many tasks added to their jobs in recent years. Moreover, the teaching time given to departments of preventive medicine in medical schools is generally so small that it is impossible to cover many of the important areas. Finally, when one considers the fact that the curriculum of the medical student is already loaded with many so-called core subjects, it is difficult to add emphasis in any particular area without removing something elsewhere. Nevertheless, it might well be said that the basic problem in presenting significant material on environmental health to medical students lies in the choice of the curriculum and thus the means by which this is done should be considered briefly.

Most of the medical schools in the United States divide their programs into the pre-clinical and clinical years, roughly devoting two years to basic science subjects and the last two years to clinical subjects, wherein patients are studied and treated. Generally speaking, the objective is to produce a young physician who might accept appointment for further study to become a generalist, a clinical specialist of one type or another, or a medical scientist. In this arrangement, some 1500 to 1600 hours are directed to pre-clinical subjects in the medical school with some 1600 to 2000 hours being devoted to the clinical subjects in the last two years.

TRENDS

Recently, some medical schools have introduced clinical subjects in the first two years, sometimes beginning in the first year, so that patient contact becomes a reality for the student early in his training. When this is done, some hours are either added to the curriculum or subtracted from something that was offered in the previous year. Another trend that has become popular within the past few years is the teaching of the anatomy, physiology, biochemistry and the pharmacology of organ systems rather than teaching along classical departmental lines with regard to anatomy, biochemistry, physiology, pharmacology, etc. In some instances, subjects which do not lend themselves easily to the organ system approach are taught separately, or they may be approached in a pre-organ systems course arrangement.

Lately, students have been given the opportunity to develop along a chosen line in the clinical years in that tracks or pathway curricula have been developed in many schools, particularly newer institutions. For example, at the University of Washington, four pathway curricula are available for the student's choice for his clinical years. These are as follows: the family physician pathway; the clinical specialist pathway; the behavioral specialist pathway; and the medical scientist pathway. Each of these pathways has special requirements, but each also provides the opportunity for additional electives of interest to the student. Special programs leading to the combined M.D.-M.P.H. degrees also afford opportunity for input on environmental health matters.

By and large, the flexibility offered by elective courses, pathway selections, and organ system teaching usually is found in the newer medical schools in the United States. This group includes approximately 12 percent of the 110 schools. Most of the older schools still divide their curricula into pre-clinical and clinical phases and many of these tend to add absolute requirements in each phase of the student's education so that variation is hard to come by in the program. Generally, departments of community and preventive medicine have about 80 to 100 hours out of the total of 3800 to 4300 hours in the curriculum to present the basic information concerning epidemiology, biostatistics, health care delivery and community health (3). One would expect that significant course offerings might be available in schools which have fairly well established environmental health programs, and these schools number about 12 of the 110 schools in the United States. However, these institutions are all well established institutions with curricula which have changed but little with the years. As such, new inputs are difficult to achieve in any of these, since most discussion of changes in a curriculum meeting resembles union negotiations, especially if time additions are a consideration. Some schools have tried to solve this dilemma by offering elective courses in environmental health and in fact, some of the new schools also provide special field experiences.

The average medical applicant today is very well read, having perused the books of Rachel Carson, Barry Commoner, Ralph Nader and René Dubos, all of whom have a great regard for the environment. Moreover, many of these students have participated in Earth Day and subsequently devoted themselves to continuing action through groups such as Environmental Action, or similar special interest organizations. Often through the Experimental College program or the underground university, they have started courses which have been so well developed and have become so popular that they have been given serious consideration by the University. For my own part, I can say that the interest and activity of these individuals have been very helpful in course development in medical schools, since often the approaches which are made in developing these courses are those which tend to stimulate the interest and maintain it at a fairly high level during most of the course.

Having said all this, the question is, what does the future hold for the teaching of environmental health in medical schools? Since this depends on so many different factors, I am not at all sure that I have the answer; however, I would hope to see the development of more interdisciplinary courses wherein the various functional areas are integrated into the teaching effort for the particular subject matter.

On many campuses, the interface between medicine-engineering and medicine-physics has already been broached with the formation of multidisciplinary research teams. Many of these have later developed special courses for graduate students. I expect that we will see more of this in medical schools, particularly in the new schools which are adopting new curricula and which do not seem to be tradition-bound. However, we already see that some ivy-league medical schools are changing some of their newer curricular offerings and returning to the traditional way of doing things. Although it is not totally clear why this is so, it has been said that this is due to the standing of their graduates on certain national examinations.

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THE HUMAN ENVIRONMENT AND "QUALITY OF LIFE"

Peter J. Copek

As a teacher of literature committed to the study of social novelists whose work was a response to the development of our industrial society, I am nevertheless haunted by a remark of Virginia Woolf each time I am tempted to prescribe a course of action, to solve social problems, to plot strategies for survival: the novel, she said, should not lead us to do anything, much less join some society, attend a conference, or worst of all, write a check. I, however, believe that art can make things happen, sometimes keep things from happening; but it is wise to begin with Virginia Woolf's warning if only as a reminder that the humanist's studies are very often necessarily studies of attitudes and feelings, not facts; symptoms, not cures; problems, not solutions.

Moreover, the humanist finds his attention fixed on the past more often than he does on the future; he seems at times contented with language and thought for their own sake; he does not seem at first glance particularly fit to be talking at conferences with words like "survival", "planning", or "tomorrow" in their titles. But let us remind ourselves once again of that good old environmental maxim--"everything is connected to everything else." Though we are now keenly aware that we are related to each other and related to the land, we still are not sensitive enough to the fact that in the rush of modern times we may have moved too fast, forgotten too much, and left our past dead and behind us.

It was with this in mind, then, as a humanist who distrusts "applied humanities", that I began a program in western Oregon this past summer, leading a group of humanists from Oregon State University who coordinated town meetings in the Willamette Valley and on the Oregon coast. At a time when the organization of our technological society seemed to be sputtering and there was some question whether or not the perennial answer "more technology" would get us running again, I thought it would be interesting to go into various Oregon communities, to talk with the residents about what they considered essential to the "quality of life" in their communities, what they felt they shared as members of a community, what connection they felt to their local region, what connection they felt, if any, to the so-called Oregon consciousness or Oregon Story,

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Peter J. Copek is Assistant Professor of English at Oregon State University, Corvallis. He received a grant from the Oregon Committee for the Humanities to direct a program and symposium, "Modern Times: An Exploration of Community" in the summer of 1974.

whether in fact such a Story existed at all or was simply a fantasy of Governor McCall and the Eastern press.

The program was called "Modern Times: An Exploration of Community", and it ended when members of the communities we visited throughout the summer came to Corvallis last month both to listen to and speak informally with men and women from Oregon and throughout the country who have spent much of their lives looking at various aspects of life in the modern community--its jobs, its architecture, its government, its literature, its social groups, its identities (real or willed), its transportation--relating each to each; and we hoped the discussion would become part of our consciousness, our awareness, which we could then use to consider and decide upon specific community problems.

I want to return to some further observations and conclusions about the "Modern Times" program. But besides work the humanist may be doing in the community, I want to stress that, unless we restrict our definition of environmental education too narrowly, what the humanist is doing in the classroom and the library, as well as in the community, is essential to our environmental awareness.

Take the case of literature. Over two hundred years before Earth Day, writers were responding to the new and changing shape of the world created by mechanical industry. In fact, a new art form, the novel, was conceived simultaneously with the Industrial Age, and through most of its history the novel has been a continuing response to the growth and development of its twin rival. The effect of industry on the external environment as novelists have recorded it hardly needs retelling here, for in the past ten years we have all become convinced environmentalists of one sort or another, even those of us who qualify this article of faith by talk of "trade-offs". What should at least be mentioned, though, is that the literary response to industry has carried into the twentieth century with increased intensity and urgency. You need only view Dickens' Hard Times (1854) and D. H. Lawrence's Lady Chatterley's Lover (1929) side by side to see how the problems of industry have multiplied and how the literary responses have been complicated. Nineteenth-century Coketown, the "key note" of Hard Times, as Dickens called it, is an ugly sore, with its grim red-brick architecture and ever-active bottle ovens and smokestacks, but as the long-distance panoramas of Dickens' descriptions reveal, it is still merely a sore on a landscape that is for the most part sound and green. Stephen Blackpool, Dickens' hero, is within walking distance of a smokeless pleasant land where the stars still can be seen to shine at night. But one can walk all day, even take the car as Lawrence's Connie Chatterley does to ride through Tevershall, and find nothing but "incarnate ugliness, and alive!"--a totally blasted landscape that surrounds the small preserve of green at Wragby and a diminished Sherwood Forest. What once was just a sore has become a virulent disease, and the natural world is threatened with total extinction. Topographically, Lady Chatterley is the tragic inversion of Hard Times.

Of course writers have seldom liked machines. They have for the most part cherished the diversity of life in the face of a world that was becoming increasingly standardized and mechanical; they have valued the exotic, the imaginative, the strange. They have doubted that an industrial age would do any better in erasing the age-old fundamental problems of ignorance, poverty, starvation.

The image of the world, as a social novelist since the Industrial Revolution may see it, is not the same as that silent cool wafer of earth captured by cameras from the moon; rather the image might be of a lump of fuel, first smoldering, then burning in the heavens; and now at its hottest brilliance its inhabitants are wondering whether the second law of thermodynamics or common sense may be telling them that, given the world's finitude, hottest cannot get much hotter, and one way or another we must cool off gradually or burn what we have quickly and be left on a dying ember. The truce of Earth Day would have seemed inevitable to nineteenth-century novelists, even though they may have been surprised it occurred so late.

This sort of image will not add "factually" to the debate between neo-Malthusian proponents of limited growth and those who still apparently remain the prevailing voice of the American business community, those believers in limitless expansion, production, and consumption. This sort of image-maker is more interested in rhetoric, in persuasion, than in logic; he wants to carry a truth to the imagination, not simply to reason, knowing that if the image is successful the truth will be more powerful.

No, this adds nothing "factually" to the debate, but then very often the facts are misleading. We have all been asking too long questions of fact--"can it be done?", "will it work?"--and pushing aside questions of values--"do we want it?", "is it good?" We have so distorted the world by quantification, it is a wonder we have not rewritten the account of the sixth day of creation to read, "And God saw all that he had made, and said, 'It works!'" We give lip service to phrases like "quality of life" but when the chips are down, we count them; "quantity of life" is what we really mean.

I would agree with John Wilkinsen's application of Engel's law that "it is, in fact, the essence of [the technological society] to compel the qualitative to become quantitative, and in this way to force every stage of human activity and man himself to submit to its mathematical calculations"; (1) and it is the French sociologist, Jacques Ellul, who has given us the most comprehensive description of this kind of society. And each day new examples of this process are striking us. Recently, at a hearing before the Public Utilities Commission considering rate increases for Pacific Power and Light, one citizen struck what seemed to be a strange note to the representative from the power company. He did not ask about how the new rate increase would affect farmers with large irrigation systems; he did not protest the indirect and hidden cost of the rate increase (such as new taxation resulting from the increase in the cost of maintaining libraries and school systems) which he would pay in addition to his own light bill. These were valid questions, but his training and inclination prohibited his arguing these issues to the penny and percent. He was not sure whether the increase was equitable, whether the company needed it to maintain adequate service as well as a profit large enough to induce investment in the company so that new plants could be built. He simply wanted to know, and he did ask, whether we wanted new power plants in adjoining states and thereby inevitably more industrial growth in the Willamette Valley. He wanted to know whether the company, outside of its advertising department, had ever thought about the effects of growth on community, whether indeed progress should be their most important product. His question turned out to be rhetorical, for the company officials gave him no answer, not one word.

This brings me back to the approach of our community program, "Modern Times". Studs Terkel, the Chicago radio journalist who was one of the conference participants at the close of the "Modern Times" program, has recently written a book, Working, whose subtitle is "People Talk About What They Do All Day and How They Feel About What They Do". What we hoped would begin to happen and continue at the conference in the fall might be called COMMUNITY, "People Talk About Where They Live and How They Feel About Where They Live".

We didn't wish to focus either the local meetings or the fall conference on immediate community problem-solving. It would have been presumptuous of us and insulting to local citizens to travel to Albany or Salem or Tillamook, say "What's your problem?", come up with a quick solution, and leave in a cloud of dust for Corvallis.

We thought, in fact, that too much pressure had been placed on citizens to solve this or that problem, NOW. No doubt many of the issues facing the state in the next few years are urgent and need immediate attention. But when the individual citizen is asked to express opinions on issues as diverse as field burning, utility rate increases, town planning, economic and industrial growth, and coastal conservation, he or she is unlikely to be able to respond to various experts in these areas who can argue the issue to the penny or percent, and many citizens then simply shrug and become unconcerned through frustration, not apathy. People are pounded down, battered, swamped by facts and data, as if that alone were necessary and sufficient for decision--totally forgotten sometimes are questions of values. Again, the question seldom is, "is it good?" The question more often becomes, "can it be done?", "will it work?".

We began each local meeting with the screening of the Charlie Chaplin classic, Modern Times, because Chaplin gives us the dominant image of the economic urban age: a vast city, an enormous factory, an environment which is impersonal and mechanical. And the individual within this environment, who is responsible for having created this environment--or at least for allowing it to go on--becomes its slave. What Chaplin objects to is not machines and industry as such--he objects to a machine philosophy, that man, having created machines, has then recreated himself in his creation's image. In the movie, it's almost as if Chaplin's bones have been replaced by high tensile steel, his nerves by wires, as Chaplin the worker routinely turns out products on the assembly line and is in turn just another product assembled by the city.

In the last scene we see Chaplin and Paulette Goddard walking up the center of a highway heading out of town. They walk off into the sun, away from the hassles and horror of the city and into the promised land of the West, and as everyone in the theatres of the 1930's would have recognized, the promised land they were heading for was California.

And the point was missed by very few in our Oregon audiences, even though they might not have been aware of the results of a recent survey conducted by Dartmouth College in New Hampshire, and repeated in Minnesota, Indiana, Illinois, and California. Respondents were asked to make a "quality of life" map of the United States. They were told to pretend that "[they] have just been promised a job by the Allstate Money Company. You have your choice of location in any one of the continental 48 states, U. S. A. Irrespective of where you live, your income and costs for the year will be exactly the same." (2) Where would you move? Though California still ranked high, especially among the undergraduates, it is clear California is no longer the promised land of the 1930's. But what has replaced it? Oregon, which was ranked second by undergraduates, and third by alumni. In fact, Dartmouth alumni placed only New Hampshire and Vermont ahead of Oregon, no doubt because they still relive their college days in the nostalgic memory of those mysterious hills. But if it is impossible to migrate to the past, it is not impossible to move into the Willamette Valley, especially since, despite James G. Blaine societies and border fences, it is clear that many in the state have been growing wide-eyed as they see the tremendous opportunities to capitalize on Oregon's new popular image. As the Dartmouth surveyor correctly tells us, "Differences in the perceived character of places have always been one of the chief interests of the geographer because it is these differences which generate flows of people, of goods, of services, and of ideas." The flow seems to be northwestward, and it seems not so much because the Oregon Story is perceived as a set of recent responsible legislation but because it offers an alternative to the failing technological way of life. The paradox, of course, is that a massive influx of people and industry will quickly change the community so many thousands are seeking in coming to Oregon. They will bring with them what they wished to leave behind.

Before I began the "Modern Times" program, I suspected that the main reason Oregon had withstood so long being swallowed up in Corporation America was that it was out of the way, "submerged in stagnancy" as one student from the East told me, tucked away in the corner of the map. Now I am not so sure. In town after town I have heard variations on a speech I have read recently by an old Oregonian, E. R. Jackman, author of The Oregon Desert, a speech called, "Oregon, A State of Mind". "The ancestors of the true Oregonian", says Jackman,

> did not come here to get rich. They came to make a home. And, as I have pointed out, they proceeded to do just that. They have been at it ever since. They aren't much interested in being great men....
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> We hear much in the newspapers now of efforts to bring industry to this state. The persons I speak of would vote, I believe, 100 percent against it. Why should we fill our clean air with fumes, use our water for factories, fill our welfare rolls, get in thousands of people who know nothing of Oregon history and care less? The old Oregonians are deeply resentful because the war industries brought 300,000 or more here from other states. Not that the newcomers are worse, but their standards aren't the same. They tend to vote as a herd, for example, with little consideration for the merits of the candidate.
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> A typical Oregonian isn't proud or stiff backed, he just doesn't care what others think of him. Californians rail and ridicule. They say we are backward, asleep, that we make no advances except as we are forced to. The old type Oregonian couldn't care less--he doesn't even hear them, and what they call progress he regards as a trend toward an inferior way of life. He is strong for education, but he wants plenty of leisure. (3)

This speech was delivered in 1961, long before the "environmental consciousess" took form, when billowing smoke was not thought of as pollution but prosperity. It is the speech of a man who might even be called a patriot, a charged word, I know, but a patriot not because he would join patriotic associations--associations, incidentally, which only began to be formed in the late nineteenth century when Americans began to have trouble deciding what a patriot was--a patriot not because he wouldn't join "unpatriotic organizations" or think unpatriotic thoughts or do unpatriotic things; but a patriot in the sense John Schaar speaks of when he points out that when George Washington spoke of "my country", he meant Virginia; a man with a sense of gratitude for his place, and the scenes, customs, and people associated with it. (4)

I know there is a danger in this position as well, that it might lead to an intolerant belligerence toward "outsiders", and finally to an authoritarian community, a "purified community" as Richard Sennett calls it, that would prohibit diversity and change. William Stafford, who presented one of the Oregon stories at the conference, quietly pointed this out: "From our snug place we shout religiously for attention in order to hide." But this has been a problem of most American cities (witness the events of the 1968 Democratic Convention where "outside agitators" were anyone who would not submit to the official Chicago party line), not simply a characteristic of environmental "purists".

At a time when our economic despair may tempt our society to abandon all restraints on corporate state capitalism, let us remember to keep in view the entire environment of humankind. When we talk of "quality of life" we should mean quality of life. And, finally, let us respect our opponents. It is easy to listen to people in Corvallis, Oregon say that a continued view of an undeveloped Mary's Peak is more important to their "quality of life" than thirty or forty extra dollars per month in pay. And it's nice to hear Studs Terkel remind us of the old IWW "quality of life" motto: "Bread, and Roses Too". But when a representative of a large chemical plant is pressed at an Albany meeting for an answer as to when his plant would stop spilling its noxious clouds out over the town and across Interstate 5, and when he remarks, "Money smells good," what do you do? Well, perhaps first, praise him for his conciseness of expression; second, admire his honesty; and third, press him even harder.

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ENVIRONMENTAL EDUCATION: OF, BY AND WITH LAWYERS

Linda K. Lee

It's not very often that we at Gonzaga have an opportunity to welcome the University of Washington and I'm very happy to be able to do that this morning. I hope it means that we can continue talking to each other and working together in this very important area of environmental education.

One of the disadvantages of being the anchor person on a panel is that you sit there and think, "Why didn't I think of that?" At the same time, you occasionally have an opportunity to pick up a couple of things and take off on them.

I found out about this meeting very late in the game, and therefore I fear that I'm not as well prepared as my colleagues, but I do have some comments--what lawyer doesn't?

I discover that, like Dr. Wilson, I'm a transplant from that other Washington, and probably even a more recent one. I've been here about two and one-half months. But in that brief period of time in the Inland Empire I have discovered that there are a great many people who think that this is the promised land. It won't be unless we all work together to keep it that way.

We at Gonzaga have been very active at the Law School in the whole area of law and the environment. In fact, just last weekend we had an event from which we are still reeling. We had a law and environment symposium that was organized, run, and totally conceived by our students, which is an indication of Dr. Wilson's point of how interested students are today in this field. We ended up with some 630 registrants, and took over practically every building with classrooms and every motel in town that wasn't already taken by Expo visitors.

As one of the hosts of the event, I wandered around from panel to panel, and in practically every one I attended, the same joke was told. I'm not going to tell it again. However, it's the one about Moses and the parting of the waters and he'd forgotten to file his environmental impact statement. As I was suffer-

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ing through this for about the eighth time, someone handed me a document which I think is directly relevant to my topic. This question is often raised. "Have the lawyers made the environmental problem worse by interposing a new system of laws and regulations?"

One of our guests last week handed me a document which is signed by a source unknown. It is called The Manager's Letter, from the Chelan County Public Utility District, Vol. 17, No. 28. It is entitled "Genesis 1974". I won't read it all because it is rather long, but it's too good to waste.

> In the beginning, God created heaven and earth. He was then faced with a class action lawsuit for failing to file an environmental impact statement with HEPA, Heavenly Environmental Protection Agency, an angelically stacked agency, dedicated to keeping the universe pollution free.

God was granted a temporary permit for the heavenly portion of the project, but was issued a cease and desist order on the earthly part, pending further investigation by HEPA.

When asked why he began these projects in the first place, he simply replied that he liked to be creative. This was not considered adequate reasoning and he would be required to substantiate this further. HEPA was unable to see any practical use for earth, since the earth was void and empty and darkness was upon the face of the deep. And God said, "Be light made." He should never have brought up this point, since one member of the council was most active in the Sierrangel Club, and immediately protested, stating "How was the light to be made? Would it be coal fired or nuclear fired generating plant?"

This goes on at some length. Finally it turns out that God said, "Let there be firmament made amongst the waters. And let it divide the waters from the waters."

One ecologically radical council member accused him of double talk, but the council tabled actions since God would first be required to file for a Firmament Permit from the ABLM, that's the Angelic Bureau of Land Management.

Well, this goes on. It appeared that everything was in order, until God stated that he wanted to complete the project in six days. At this time, he was advised by the council that his timing was completely out of the question. HEPA would require a minimum of 180 days to review the application and the environmental impact statement. Then there would be public hearings. It would feasibly take ten or twelve months before a permit could be granted. And God said, "To Hell with it."

I feel a little bit, this morning, like the children's story character with 500 hats, Bartholomew Cubbins. I am a lawyer, a teacher of law, a legal administrator, former politician, former Congressional assistant, and former member and counsel to the National Advisory Council on Environmental Education. This morning I speak as a lawyer.

It's often said that lawyers are the last of the great generalists. That may or may not be true in an age of increasing specialization. But the very generalist nature of our profession enables us to be very enterprising because we can incorporate the environment into nearly everything we do.

One hat I forgot, that was raised by Dr. Wilson's remark about curriculum committees. I chair the committee on curriculum for Gonzaga Law School and I am becoming something of a broken record about injecting environmental elements into the curriculum. We teach environmental law. We teach environmental administrative law. We teach land use planning and things of that nature. But we also have the opportunity to incorporate the environment into just about every other area in our curriculum. We have a law and humanities program, which began last year and will continue this year, and this year it will have a very major environmental theme.

In basic property courses we discuss land use planning and zoning. When we teach procedure, we come to such things as "Who has jurisdiction over what?" We talk about class action suits. As a matter of fact, we just had a very fascinating case come down from the Washington State Supreme Court. It is something of a landmark, although the court was sufficiently divided to make it a good law review topic. What it held, essentially, is that non-abutting property owners had standing under the State Environmental Protection Act to sue the State Highway Commission on the grounds of potential noxious fumes and potential damage to property values.

In the torts area, and for those of you who aren't aware that isn't something to eat, it is referred to as a civil wrong, such things as nuisance, for which one may collect damages; this is another course in our curriculum.

In constitutional law we talk about problems of eminent domain, due process, all of which can be illustrated by examples from the environmental area. Administrative law is, of course, an obvious one. I think if my administrative law class hears me say one more thing about a Ruckelshaus case, they're going to throw something at me, but there's always a way to work it in. When I teach legislation, I get into the history of the National Environmental Protection Act, as well as the Environmental Education Act.

It is perhaps in the area of evidence that the interaction of our disciplines becomes most important, because among other things we talk about the use of the expert witness. How do you examine your own expert witness or try to discredit the other side's expert witness? That is another area in which we can teach the environment through the regular curriculum with the aid of environmentalists in other disciplines. In doing this, we are fulfilling the best definition of environmental education that I've ever seen, which is the one contained in the Environmental Education Act:

> The term "environmental education" means the educational process dealing with man's relationship with his natural and manmade surroundings and includes the relation of population, pollution, resource allocation and depletion, conservation, transportation, technology, and urban and rural planning to the total human environment.

That can be true, not only in grades K through 12 and into college, but I think it's true in the professional schools as well.

There is also a role for the lawyer as educator. We can help the scientists, just as the scientists can help us. In pointing out how you take this expertise and use it to achieve a political or legal end, whether it be the establishment of legislation, the bringing of a suit, or whatever, it sometimes takes a lawyer to tell the bureaucrats how to read their own regulations.

This was very true, for example, in the Overton Park Case, which involved the question of whether or not the Federal Highway Administration could take park land from Overton Park in Memphis, Tennessee, for a highway. This case did not reach the Supreme Court under an environmental act per se. Rather it came up under Section 4(b) of the Transportation Act. The point was, that here was a place where we as lawyers had to go all the way to the Supreme Court to tell the Department of Transportation how to read its own regulations. These provided that before park land could be taken for highway purposes, there had to be some serious non-environmental justification. The Supreme Court said, "Go back and read your own enabling act and rules. You didn't even follow them."

And, certainly there is a place for the lawyer to help educate the citizen. Granted, we're all citizens, but I've had citizen groups come to me and say, "What, legally, can we do about thus and so. They're about to dump X into this little stream, or they're not going to let us fish here anymore, etc." And I think the lawyer has a very important role here.

What are your rights? How can you express them? What is your best strategy? Should you call for a hearing? Should you get your legislator to introduce a bill? When is it wise to sue? When is it wise to threaten? When is it wise to elect a new representative?

Now, for most of us in this business this is pro bono work, squeezed in between paying clients, but this is an area where a lawyer has a real responsibility. The law can be a contributor rather than an obstruction to environmental quality.

Dr. Copek reminded me, when talking about development, technology and industry, of an interesting city that I visited many times when I was a congressional assistant. My Congressman was from the area around Lowell, Massachusetts, which was probably the seat of the industrial revolution in New England in the textile and shoe manufacturing era of the mid-nineteenth century. It's an old mill town. Unemployment is high, the mills are ugly, or were. It was really a company town.

You lived in the company house, you shopped in the company store, you went to the company church, etc. But even in this era there's a real pride in the people of Lowell. Much of the city, by law, is going to be made a national historic park, where these things will be preserved, perhaps to some of us as reminders of a past, as Dickens would have us believe, that never should have happened. In another way it reminds us of our mistakes and gives us an incentive not to repeat them.

I remember being in Latin America a couple of years ago on an environmental study mission, where we were trying to help some of the governments of Central America with their development problems, and trying to help them avoid the mistakes we made.

There is a lot of resentment in the developing world. "Well, you're just trying to keep us down, you don't want us to develop, so forth and so forth." All of us in this particular group were environmentalists of one sort or another. There were a couple of educators, psychologists, industrial planners; I was the lawyer on the team. And the point we were trying to make to them was, "Look, we made mistakes. And we know it. But through law, you can avoid them." So here again the lawyer has a role as educator.

Perhaps most important of all is the role in education that we lawyers and those of you in other specialties and disciplines have to educate each other, and together to educate others. As I said before, lawyers are the last of the great generalists. That sometimes means that other people say, "Well, you're really superficial. You don't know all there is to know about molecular biology and so on." On the other hand, I think the lawyer can justifiably say to the scientist and to professional ecologists, "Well, you may know all there is to know about molecular biology, but how do you tell that to the people, how do you tell it to the judge and jury?" It's a two-way street.

In many ways, the lawyer and the scientist together can interact and help each other toward a common goal. We need your expertise and perhaps you need ours. Together we can do something. There's nothing mutually inconsistent about the goals of all of our disciplines.

If we're elitists, an accusation often made, then so be it. We aren't the only people that have something at stake here. It's not your expertise, as a whatever-you-are, as a doctor, biologist or chemist. It's not my expertise as an attorney or a politician. We're all in it together. And because, perhaps, of our very elitism, our experience and training, and because of the fact that the world belongs not just to us but to everyone. Everyone didn't have the advantages that we had of education, expertise and experience; that makes our responsibility all the greater not only to work together but to help to advance the cause of environmental education for ourselves, for each other and for all the citizens of the world community.

WHERE WILL THE MONEY COME FROM?
FEDERAL GOVERNMENT SOURCES

Michael E. Steward

If Senator Magnuson could be here, I know he would be pleased to see that so many persons from across the country have come here to the City of EXPO 74 for these discussions on environmental education. Certainly, one of his hopes for the Fair, in working to obtain its approval and funding by Congress, was that it would serve as a focal point for just such discussions.

According to the agenda, this portion of the program is entitled: "Where Will the Money Come From?" By way of preparing you for my next few comments, let me suggest that perhaps a better title might be: "Where--Oh, Where,--Oh, Where, Indeed--Will the Money Come From?"

According to information compiled by the Council on Environmental Quality, the Federal Government is now spending roughly the same amount for environmental education as it spent in Fiscal Year 1972--about $24 million. Given inflation, then, there is actually less available in real terms now than there was three years ago. And the future, at least the immediate future, is not promising, given the need to cut federal spending in the face of double-digit inflation.

Last January, the former President sent Congress a $306 billion budget. What has happened to that budget thus far?

The Appropriations Committees have recommended--and Congress has approved--modest increases in some programs and major reductions in others. For example, defense appropriations approved by Congress for this fiscal year are almost $5 billion under the amount requested in the Presidential budget. The net result of Congressional action so far on appropriations bills has been a budget cut of about $3 billion.

A great share of the annual federal budget is not, however, subject to the control of the Appropriations Committees. So-called mandated expenditures for

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Alice Shorett was the moderator for Session 6.

such items as pensions and public assistance account for well over 70 percent of the total budget. And they continue rising.

Thus, the $3 billion cut made by the Appropriations Committees has already been nearly consumed by increases in mandated spending. As of now, then, we face projected spending of about $306 billion for this fiscal year--or the amount originally recommended in the Presidential Budget submitted last January.

Now comes the crunch. As an essential part of his economic program, President Ford has said the federal government should spend no more than $300 billion this fiscal year. In other words, the President has determined that the original Presidential budget of $306 billion should be cut back to no more than $300 billion. That leaves $6 billion to be cut.

Looking over the horizon, then, to November 18, when Congress reconvenes, we can expect to see the President sending Congress a series of budget deferral and rescission messages. In other words, he will be recommending that Congress permit him to either defer until next year spending originally planned for this year or to cancel planned spending altogether. In sum, this is a time of cuts almost everywhere, holding actions in a few cases and increases almost nowhere. Given that picture and the budget priorities of the current Administration, one cannot easily predict large increases any time soon in federal financial support for environmental education.

Educators are certainly not without some powerful allies on the Appropriations Committees. As Chairman since 1969 of the Senate Appropriations Subcommittee on Labor and Health, Education and Welfare, Senator Magnuson has consistently sought reductions elsewhere in the budget so that more could be provided for the nation's critical "people programs". Year after year, his Subcommittee has carried the banner for a re-ordering of national priorities so that health, education and job-creating manpower programs would receive a more reasonable share of the limited federal budget.

But your allies need your help. That requires your understanding the appropriations process so that you can affect the decisions it produces. Thus it is worth taking some time here to define a few key terms and to outline the annual appropriations cycle.

It is important to remember the difference between authorizing committees and the Appropriations Committees--and between authorizing legislation and appropriations bills. The House and Senate each have several authorizing committee writing authorizing legislation while each body has only one Appropriations Committee writing appropriations bills. The relationship between the ee authorizing process and the appropriations process is, of course, that authorizing legislation determines what may be spent by setting appropriations ceilings while the appropriations bills say how much can be spent within those ceilings.

For example, an authorizing bill written by the Senate Labor and Public Welfare Committee might say $50 million may be spent during Fiscal Year 1975 for a particular education program. But the Labor-HEW Appropriations Bill for Fiscal Year 1975 may provide only $30 million to the Office of Education to conduct that program.

The appropriations process begins anew each year when the President submits his Budget in January or February. The Budget is parceled out--essentially by Department and Agency--among the thirteen subcommittees of the House and Senate Appropriations Committees. Thus, for example, that portion of the President's Budget devoted to the Office of Education is parceled out to the House and Senate Labor-HEW Appropriations Subcommittees.

With the President's budget recommendations as their starting point, the thirteen separate subcommittees in both the House and Senate begin their public hearings. Typically, Department heads and other agency officials appear first to "justify" and defend the President's recommendations. Once the Administration has had its "day in court", the subcommittees hear testimony from Members of Congress and from outside--or public--witnesses.

The subcommittees' public hearings give you your first opportunity to have a direct, personal, and formal input into the appropriations process. Used effectively, this opportunity can pay important dividends. How do you use the opportunity effectively? Several points. First, as soon as the President's Budget is submitted to Congress, determine what he is recommending for the particular program in which you are interested.

Now that you know what the President is recommending, you know--essentially--whether you have a problem or not. Generally, at least with respect to the kinds of programs in which you are most apt to be interested, if the President requests funds in his Budget, those funds will be appropriated when the process is completed. You may wish to file a written statement with the relevant Appropriations Subcommittee in support of that Budget recommendation, but chances are that there is little, if any, need to actually request an opportunity to testify in person during the public hearings.

If the President's Budget does not recommend what you feel to be the necessary amount for a particular program--then you have a problem. How do you solve that problem during the ensuing appropriations process? First, make certain that it is solvable. In other words, make sure that authorizing legislation is in force that permits the Congress to appropriate the amount you believe necessary. Having determined that to be the case, determine which subcommittee in the two Appropriations Committees handles the funding for that program.

You now know four key facts. You know specifically in which program you are interested. You know whether you have a problem or not. You know whether that problem is solvable through the Appropriations process. And you know which subcommittees in the Senate and House can potentially solve that problem. Now look for a friend in court.

If your Senator or Congressman is a member of the relevant subcommittee, and if you can make a strong case for your recommendation, chances are you have found an advocate for your cause. Or, you may find that there is a member on one of the relevant subcommittees who has evidenced a strong positive interest in the program about which you are concerned. If you find such a friend in court, then immediately contact him or her, lay out your case, and seek their advice and assistance in the appropriations process.

If you have not identified an obvious ally, then write the chairmen of the relevant subcommittees and specifically request an opportunity to appear and testify. You may wish to make that request through your own Senator or Representative. If you are invited to testify--and you probably will be--come prepared with a written statement that is specific, detailed, and thorough--but don't plan on reading it. Instead, summarize it in four or five minutes. Your written statement will be read and it will be important to the Subcommittee's ultimate decision. But the objective of your personal appearance before the subcommittee should be to answer questions the members may have.

You have now appeared and testified before the relevant subcommittee in one or both of the houses. What happens next?

Public hearings on the appropriations bill proceed concurrently in both the House and Senate. But, by tradition, the House always passes appropriations bills before the Senate. Consequently, the House Subcommittees are the first to "mark-up" their bills. It is in these mark-up meetings--which begin in the early Spring and typically take a day or less--that the first crucial Congressional decisions are made on appropriations. When a House Subcommittee concludes its mark-up, it has generally determined the position of the House of Representatives on 95 percent of the items covered in the bill. Consequently, if the subcommittee marks-up the bill with your recommendation contained in it, the chances are excellent that it will also contain your recommendation when it passes the House. If it doesn't, then your chances for success are considerably less.

This is the case since the Full Appropriations Committee--which must review the bill before it goes to the House floor for a vote--by and large automatically approves the recommendations made by the subcommittee which has conducted the public hearings and heard the evidence. There are only about three cases where the Full Committee will make changes in the subcommittee's bill. These would be (1) where there is great public controversy over a particular item; (2) where there is an item of special interest to a Congressman who is on the Full Committee but not on the subcommittee; and (3) where the President submits to Congress a new budget request--a so-called budget amendment--after the subcommittee has completed its mark-up.

Once the Full Committee has met for its mark-up session on the Appropriations bill, the bill is reported out of Committee. In other words, it is ready for consideration by the full House of Representatives.

When the bill is taken up on the House floor, amendments will probably be offered and perhaps even adopted. These will generally fall into one of three categories. Some will be on matters of great public controversy. Others will be offered by key members of authorizing committees who feel the Appropriations Committee has not recommended sufficient funding for particular programs authorized by those committees. Finally, others will propose the addition of relatively small amounts for programs or projects of importance to a particular member's District. As I will explain shortly, however, great reliance should not be placed upon floor amendments--particularly those lacking wide public support.

OK. Where are we at this point? The House Appropriations Subcommittee has now completed its public hearings and marked-up its bill. That measure has been approved by the Full Committee and passed by the full House in essentially the same form in which it was written by the subcommittee. Your recommendation is contained in the House-passed bill, because it was included when the subcommittee marked-up the bill or because it was added either in the Full Committee mark-up or as an amendment on the House floor.

Now what happens? The House-passed bill is sent to the Senate and referred to the relevant Appropriations Subcommittee. Applying the conclusions they have drawn from their public hearings and their policy judgments, the members of the Senate Subcommittee mark-up the House-passed bill. Many changes will be made. Where the President's Budget recommended $10 million and the House $15 million, the Senate Subcommittee may allow $20 million provided, of course, that authorizing legislation permits that much to be appropriated. Or, where the Budget and the House have both provided nothing, the Senate Subcommittee may put in money, again provided that there is sufficient authorization. Or where the House may have provided funds, the Senate may provide nothing. The variations are numerous. As in the House, the Full Senate Appropriations Committee generally approves the subcommittee's recommendations. The measure is then reported by the Full Committee to the Senate floor where again amendments may be adopted before the bill is finally passed.

We now have a House-passed bill and a Senate-passed bill. There are numerous differences between the two versions. Consequently, a House-Senate conference committee must be appointed to meet and resolve the differences. So what happens to your recommendation when the conference committee meets and writes the final bill? Well, you may be fortunate enough to have your recommendation contained in precisely the same form in both the House and Senate-passed bills. In that case, you are home free--barring a Presidential veto or subsequent Congressional approval of a Presidential deferral or rescission message that either defers spending the funds you sought or eliminates them altogether.

But--alas--you have not been so fortunate. While the House-passed bill contains the funds you recommended, the Senate bill does not. Let's use a concrete example. Say, the House bill provided $1 million while the Senate bill provided nothing at all. The conference committee then has a million and one options. It can approve anywhere from zero to $1 million. What are your chances of coming out closer to the latter than the former?

Several factors must be considered. These include (1) the extent, if any, to which the bills exceed the President's Budget recommendations--the greater they exceed the budget the greater the chance of a veto, and therefore the greater the pressure on the conference committee to make reductions; (2) the degree to which increases recommended in the House bill exceed or are less than the increases recommended in the Senate bill--in other words, which side must give up the most in conference if the final bill is to be reasonable; (3) what the Senate conferees have heard from their constituents or from other members of the Senate about your proposal; and finally--but especially significant--at what point in the process was your recommendation added to the House bill. Why is that so important? Simple--the members of the conference committee are generally also members of the Senate and House Appropriations Subcommittees that wrote each body's first version of the bill. Consequently, if your recommendation was adopted by the House Subcommittee when it marked-up its version of the bill, chances are excellent that they remain convinced of its wisdom and will persevere in the conference to retain it in whole or at least in part. If, on the other hand, your recommendation was added to the bill either in the Full Appropriations Committee or on the House floor, there is much less chance that the House conferees will be convinced of its wisdom and willing to go to great lengths to retain it in the final bill. Suffice it to say, then, that the earlier in the process you begin your efforts, the better will be your chance of succeeding in the end.

So, the conference committee has met, resolved the differences between the House and Senate bills, and written a final compromise measure that is approved by Congress and signed into law by the President. How did you fare?

I like happy endings, but I am also a realist. So we'll assume your recommendation of $1 million was originally adopted by the House Subcommittee whose members went to conference and insisted that the Senate conferees agree to at least providing $500,000 in the final bill. But, as I said at the outset, the immediate future is not bright so the President submits and Congress approves a rescission message that eliminates $250,000 of that $500,000. However, believing in perseverance and knowing that you do, too, we end by concluding that you will persevere, go back to Congress the following year, and convince the Appropriations Committees to provide the remaining $750,000.

On that note, let me thank you for your perseverance in hearing me out and thank you for this opportunity to be here today.

LOOKING FOR MONEY FOR ENVIRONMENTAL EDUCATION--PRIVATE FOUNDATION SOURCES

Jane McCarthy

Before I begin my remarks on funding sources to support environmental education programs I should like to spend a few minutes making some observations about the foundation world in general. In looking to the foundation world for money it should be remembered that foundations, except in rare instances, are reactive agents--they are not, by and large, initiators of grant schemes adventurously designed around innovative program thrusts. On the contrary, foundations most often simply respond to the proposals brought to them. To some extent at least, this conservative posture reflects the part-time and fragmented nature of most foundation trustees' jobs and in part it can be attributed to the lack of competent, professionally trained staff who could assist trustees in suggesting new program directions or extensions of existing program areas. In fact, it is all too common to be unable to discern any program continuity running through a foundation's grant making activities.

Typically, a foundation's portfolio of grants covers a wide range, with support for local hospitals, girls' clubs and United Fund campaigns prominent on the list. Also usually included are gifts to the donor's college and prep school. Most grant programs are clustered in the traditional fields of medicine and health, education, welfare, religion and the arts. The grants tend to be large in number, limited in their size and geographic scope and repeated year after year to pretty much the same safe beneficiaries. As I will discuss in more detail shortly, the whole field of the environment is new on the foundation scene. For this reason the burden of educating the foundation community to this new funding opportunity, or for that matter, for any other newly recognized societal need, falls on those who wish to tap this source of financial assistance.

Foundations will have to be encouraged to feel comfortable making grants in what for most of them is an entirely new field. Petitioners for these funds must aggressively sell the need for funds in this area if assistance is to be more than haphazard and spotty.

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How this educational function is carried out depends on the individual situation. An informal discussion with a local foundation official on the need for particular environmental studies program could, of course, work wonders. And if you take the time to circulate a list of local foundation officers among your professional colleagues and your friends you probably will be surprised to learn that these contacts are not as difficult to make as you would have suspected.

So much for my general remarks about private funding in the broadest terms. In preparing for this talk I sought the assistance of the Foundation Center, which is headquarters for all knowledgeable and hungry prospective grantees who seek ripe targets for their proposals. I was fortunate to find that, earlier this year, the Foundation Center had published a list of foundation grants in the general area it titled "ecology, conservation and marine sciences." This listing covers a two-year period--1971 and 1972--and it includes the major foundations and certainly all the foundations who have shown any tangible interest in the general subject of the environment. I should like to share with you some of the highlights of this report. There were 392 grants listed. These grants were made by 102 foundations. To digress for a moment, I would like to comment on the 102 foundations. The fact that over 100 foundations are actively engaged in dispersing money for environmental projects may seem to some of you impressive evidence of the interest of foundations in the environmental arena. This is not true, for the figure takes on new meaning when seen in the larger context of the entire foundation world. These 102 foundations must be viewed as a pretty lonely group when one realizes there are 31,000 private foundations in this country. While there is no question that environmental grants made by many of the smaller foundations have not been included, the point I believe is well taken...foundation interest in the entire environmental area is at best lukewarm.

Now, back to the 392 environmental grants listed by the Foundation Center publication. An analysis of these grants shows that only 43 of them could be considered grants for environmental education--even when that phrase is broadly expanded to include some citizen education efforts. To complete this really discouraging picture I could find only 10 grants, out of a meager 43, which focused on some sort of college or university level study. There were many, many more grants, of course, to universities for environmental research projects. But support for environmental studies, at either the undergraduate or the graduate level, was given in only 10 instances.

The total committed to environmental education during the period--that is, 1971, 1972--was about $6.4 million, of which $5.3 million was funnelled to colleges and universities. This figure, however, is misleading since the lion's share of it is represented by a $4.35 million grant from the Edna McConnell Clark Foundation to the Woods Hole Oceanographic Institute in Massachusetts. This grant supports a program in graduate education. If we exclude this one enormous grant, the foundation commitment to environmental education at the college and university level is a scanty $412,000.

Despite this bleak picture I don't want to give any of you the impression that it is impossible to succeed in obtaining foundation funds for assistance with your environmental education programs. I do suggest, though, that a careful reading of your target foundations is essential. There is just no substitute for doing your homework. As educators, all of you penalize students for not completing assignments, for doing inaccurate or spotty research and for committing other such crimes against the academic ethic. And yet some of you may be guilty of the same thing when you come to a foundation in search of funding.

Under the general heading of doing your homework much can be learned from a review of recent annual reports, foundation newsletters and the AR 990 tax returns filed by foundations. While these reports are out-dated and record past spending patterns, they can provide an indication of the areas of program interest, the size range of grants usually dispensed and the geographic area within which the foundation operates. These reports will also list the names of foundation trustees and staff. From these sources you can also determine when a foundation makes its grants. If grant action is taken only once a year, as is sometimes the case, and if that propitious moment has just occurred, you would have to wait out the full cycle before hearing from them. Thus, from foundation source material you can develop a list of prime suspects for your grant seeking activities and you can direct proposals within dimensions considered appropriate to the target institutions. On the West Coast this information can be obtained at the three regional branch libraries of the Foundation Center located in Portland, San Francisco and Los Angeles.

You have now culled the list and come up with a few seemingly ripe prospects to fund your new endeavor. What next? No, it is not yet proposal-writing time. At this point the really smart fund raisers come to the foundation without a written proposal. They usually start with something ingenuous like "We just want you to know what we're doing." It may seem obvious to you that it would be a poor strategy to go into a foundation cold with 10 copies of a 100 page proposal...yet this is done more frequently than program officers like to think about. You can save a good deal of time and effort if you get first-hand information about current program activities. In any event, your objective is to have the program staff put off for as long as possible a decision on your program. Try not to give him an immediate excuse to say "no."

Now to the actual proposal. There is no magic formula for writing grant proposals. But there are a few unwritten rules which are useful in looking for money. One is to tailor the size of the grant request to the dimensions within which the foundation is usually comfortable. Another is to discuss in the proposal discrete program elements. That is, if possible, steer clear of requests for general operating support. Foundations generally are more receptive to specific program activities for they usually feel more secure knowing what they have bought with their money--be it new microscopes for a biology program or support for five post-doctoral fellowships in human ecology.

If appropriate the proposal should spell out the relationship between what you want to do with private money and what is available with public funds. In other words, relate your needs to other sources of funds. Some foundations need the imprimatur of other foundations before they are comfortable lending support. Others take pride in believing they are on the "cutting edge of social change" and want to be the first-in. Offhand, the "cutting edge" argument is usually best avoided--it is a scary prospect for most foundation officials.

A fleeting word about the gentle care and feeding of program officers may also be of interest here. The program level staff at foundations generally report to another level within the foundation to receive final approval for grant actions they recommend. While in some instances this approval is more or less automatic, in others it can be a meaningful exchange of information between staff and foundation trustees and serves as a way of keeping the trustees fully informed about foundation sponsored programs. In any case, as a prospective grantee it is important that you provide the program level staff all the information it needs to properly represent your interests to the ultimate decision-making body. For example, the foundation staff person with whom you are dealing should know how your proposed project fits into the full scope of activities of your institution. You want to go out of your way to prepare foundation staff for any possible confrontation at a higher level. Not only must you do your homework, you must be sure your foundation advocate has done his or her job.

In conclusion I would like to urge you, in looking for funds, to turn, at least initially, to local sources of support--particularly for programs at the elementary and high school level. Local and regional foundations often are well acquainted with the school structure in their own communities and probably will recognize more quickly the benefits of new curricula and teaching techniques. Another factor is that the large national foundations tend to support programs which they see as having national application, whereas the local foundation seeks to provide assistance on a less global scale. In addition, sustained foundation interest may be easier to achieve at the local level. National foundations have a reputation for faddism--in some instances they have been charged with losing interest just as a program becomes fully operative. On the other hand, a local foundation with concerned home-town trustees will find it more difficult to walk away from a local project and probably will be more receptive to continued support if the project merits refunding. Another advantage of local sponsorship is that when you successfully sell a local foundation, the foundation can often assist in gathering other local interest.

To sum up...fund raising isn't easy, it is a painstaking, laborious undertaking requiring some skill but mostly persistence. Till your local gardens first, become acquainted with foundation personnel and try to tailor your proposals to the size and interest of the funding institution.

I wish you all happy hunting.

WATER QUALITY EDUCATION: GOVERNMENT'S ROLE

Clifford V. Smith, Jr.

I have been asked to speak to you today about the government's role in providing trained manpower for the implementation of strategies which are expected to achieve water quality goals. Let me begin by assuring you that the Environmental Protection Agency recognizes that the country's ability to protect its waters is directly related to the qualifications and commitment of the people charged with that responsibility. Trained manpower is a resource that is required in the implementation of every element of the Agency's basic water quality program. A special EPA manpower development and training effort begins before we reach the point where there are not enough qualified people to address the problem. In order to be assured of the availability of trained personnel, EPA must keep in close contact with the supply capabilities of the existing delivery system and future manpower demands. When a gap in the availability of manpower is forecast, EPA must formulate new manpower policies and programs which stimulate the existing delivery system to provide additional trained people. Where the existing delivery system proves inadequate, EPA must develop supplementary delivery systems.

Let me give you an overview of some of the immediate goals of EPA's manpower development efforts including examples of the types of training efforts and magnitude of funding we have seen available in the past and allocated for this fiscal year. And, finally, I believe I would be less than honest if I failed to comment on some of the problems we are encountering in this field.

First, to goals. Basically we have three immediate needs. We must assist the states in developing a self-sufficiency in developing and maintaining the supply of trained manpower needed within the state water pollution control agencies and municipal wastewater treatment authorities. Secondly, EPA must establish a comprehensive national training center capability to provide instructional materials to state manpower training programs and to provide expertise in special and advanced water pollution control techniques for use by state and local agency per-

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Bernard J. Lukco, Chief of the Academic Training Section, Office of Water Programs, Environmental Protection Agency, was the moderator for Session 7.

sonnel. And, finally, we must develop a capability in the federal government for developing and maintaining the needed supply of trained people.

Within the context of these immediate goals, let me indicate the legislative authorities for manpower training. Basically, the Water Pollution Control Act authorizes training programs including grants and fellowships for professional level training, grants to public agencies for pilot programs, and grants for the construction of training facilities for wastewater treatment operations and maintenance. The Federal Water Pollution Control Act Amendments of 1972 (Section 104 (g)(1)) provided training monies of $650,000 for fiscal year 1974. Nearly 2,000 people were trained in the operation and maintenance of wastewater treatment facilities. This training ranged from 2-day to 22-week courses. In this fiscal year another $650,000 have been allocated for the program. Under the same piece of legislation, $400,000 was spent in fiscal year 1974 to train 600 people in special university and community college level programs in the water and wastewater field, in federal agency personnel training, and in pilot National Pollutant Discharge Elimination System programs. In this fiscal year about $350,000 are expected to be allocated for the same program. Also in fiscal year 1974, $860,000 was allocated nationally under the Manpower Development and Training Act of 1962. Approximately 1800 water and wastewater personnel were trained with the help of these funds.

In addition, EPA is working to obtain funds under the Vocational Education Act to upgrade the training of treatment plant operators. There is also the possibility of using our state program grant mechanism to fund manpower development and training in the coming fiscal year.

I alluded to problems at the beginning of my remarks. So as not to make that seem mysterious or more serious than it is, let me discuss the levying of tuition charges, and the conclusion of support for graduate training.

Present regulations require all federal, state, local and private agency personnel to pay tuition for direct training courses. The regulation does provide for very limited waivers of the fee requirements until June 1, 1975. It appears that the granting of so few waivers may be having an adverse effect on the number of individuals able to benefit from the training and ultimately may be interfering with EPA's goals of developing the needed self-sufficiency among federal, state and local agencies. A manpower task force has been established and an independent contractor to EPA has been selected to look at the problem and make recommendations. In the meantime, there will be a relaxation of the stringent guidelines limiting fee waivers.

The other problem concerns graduate training. A decision was made to begin a three-year phase out of EPA funding for graduate training in fiscal year 1973. This decision was made by the Office of Management and Budget based upon four findings: One, that there was a lack of evidence of a serious gap between the supply of and demand for environmental engineers. Two, that there was an apparent surplus of engineers in other fields who might be available for retraining and staffing of environmental programs. Three, that substantial progress in the establishment of graduate training programs in colleges and universities was being made. And, four, that recent increases in salaries had been seen for environmental personnel which made such positions attractive and competitive without training grants.

I might mention that there have been several studies recently which question this line of reasoning by OMB. One study by a group of consultants to EPA, chaired by Donald J. O'Connor, concluded that federal support for professional education in the environmental field must be continued if state, regional, and federal agencies and the private sector are to have adequate personnel available to meet their needs and the goals of the 1972 Federal Water Pollution Control Act. The group recommended that the present level of federal funding for academic training programs be continued on an interim basis, that EPA analyze the present and long-term need for professional personnel, and that alternative professional education programs, such as fellowships in state agencies and continuing education classes, be studied.

Several other manpower experts have concluded that a serious gap between the supply of and demand for environmental engineers is developing. Furthermore, the U.S. Civil Service Commission has concluded that transferring engineering specialists from one field to another requires a major re-education process with a minimum of one year of formal schooling. Regarding competitive salaries, the National Air Pollution Control Advisory Committee's Report in August 1974, concluded that while salaries have increased in the environmental area, in general, the rate of increase has lagged behind that of other fields and behind the consumer price index.

As a result of this conflicting information regarding the need for graduate level training, EPA is re-evaluating its position and is considering an extension of the present funding level.

Let me now just conclude by summarizing what I have said about the government's role in developing and training manpower for the achievement of water quality goals. First, and most directly, the Federal Water Pollution Control Act provides funds for grants for professional level training and for construction of training facilities. The Manpower Development and Training Act and its successor, the Comprehensive Employment and Training Act, have been providing funds for the training of wastewater treatment operators. EPA is assisting the states in becoming self-sufficient by developing "packaged" education programs, by providing expertise in advanced water pollution control techniques, and by providing a relaxation of tuition fee requirements. There is a good possibility of Vocational Education Act funds for training of treatment plant operators, and for manpower training funds to be given directly to the state through EPA program grants.

I am optimistic that EPA will continue to recognize the critical role that manpower development plays in any effort to achieve environmental goals, whether they relate to air, to water, or to noise pollution. I am also optimistic that EPA will face the problems encountered squarely and will offer new and innovative ways to solve them.

MANPOWER NEEDS IN WATER SUPPLY AND POLLUTION CONTROL

E. Joe Middlebrooks

In a recent report to Congress on manpower development and training activities in water pollution control by the Environmental Protection Agency, Office of Water Programs, it was indicated that significant increases in manpower needs are expected over the next five-year period, 1971-1976 (1). The report shows that manpower demands are expected for a wide variety of educational and skilled categories from numerous sources and types of organizations. The report attempted to develop projected manpower requirements in all categories over the entire spectrum of firms and organizations that might utilize manpower in the water pollution control field. The number of people employed in various categories in Fiscal Year 1971 and the number expected to be employed in the same categories for Fiscal Year 1976 were broken down into four general categories. The categories included non-governmental employees, local government employees, state employees, and federal employees. The non-governmental employees were divided into the following categories: industrial, education, equipment manufacturers and consulting engineers. Table 1 shows the manpower engaged in 1971 and projected manpower needs in 1976 in the engineering and scientific areas as well as the needs for technicians and operators of wastewater treatment facilities.

Specific data describing the manpower needs for water supply activities were not available. However, most of the categories describing the needs for pollution control include personnel performing duties related to water supply activities. More information is needed, and the various agencies should attempt to compile comparable data (2).

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TABLE 1

Manpower Engaged and Projected in Water Quality Activites - FY 71 to FY 76

PERSONNEL CATEGORY	SECTORS								TOTAL	
	NON-GOVERNMENTAL		LOCAL		STATE		FEDERAL			
	FY 71	FY 76	FY 71	FY 76	FY 71	FY 76	FY 71	FY 76	FY 71	FY 76
Professional	13,200	23,400	4,300	5,600	2,100	5,500	5,800	7,700	25,400	42,200
Operator	15,400	48,700	29,700	38,600	-	-	4,200	5,600	49,300	92,900
Technician	20,500	38,900	4,000	5,200	300	700	2,100	2,500	26,900	47,300
Other	4,700	15,100	38,700	50,400	1,200	2,100	3,200	4,200	47,800	71,800
TOTAL	53,800	126,100	76,700	99,800	3,600	8,300	15,300	20,000	149,400	254,200

Source: A Report to Congress on Water Pollution Control Manpower Development and Training Activities, (1).

THE PUBLIC SECTOR

State and Local Government

The manpower needs of the local government sector for engineers and scientists are expected to increase approximately the same for both categories. The needs for engineers and scientists at the local government level are broken down into three categories in Table 2. The three categories show approximately the same percentage increase for both engineers and scientists between 1971 and 1976.

Table 3 shows the 1971 staffing and the 1976 projections for engineering and scientific staffs required by the state agencies to combat water pollution. In both engineering and scientific activities, the state governments anticipate approximately a 150 percent increase in manpower needs by 1976. The demand for operators and technicians in local and state governments will increase by 30 percent between 1971 and 1976. These projections are based upon realistic estimates of the amount of money that is likely to be appropriated for expenditure by the state governments and not the frequently used overestimations that are reported by state governments. The Environmental Protection Agency has indicated that it expects the state governments to exert more influence in the control and enforcement of water pollution control laws in the future; therefore, it is very likely that a significant increase in the number of engineers and scientists employed by state governments will occur.

The greatest difficulty that state enforcement agencies have had in obtaining qualified personnel has been a low salary scale. However, many of the more populous states have overcome this difficulty and offer salary scales that are competitive with the ones offered by EPA and private industry. Because of this salary differential, it is unlikely that the smaller and less populous states will be able to compete effectively for the top graduates in the engineering and scientific schools in the near future unless the federal government provides supplemental funds to improve the salary scale.

Federal Government

The Environmental Protection Agency has had numerous applications for employment since its inception; however, very few engineers and scientists have been employed by EPA. It appears that in the future the present trend of more non-EPA federally employed engineers and scientists in water pollution control activities is likely to continue. Table 4 shows a 25 percent increase in the number of engineers and approximately a 15 percent increase in the number of scientists that will be required by 1976 for water pollution control activities in federal agencies other than the Environmental Protection Agency. The number of engineers and scientists employed by the Environmental Protection Agency and the expected

TABLE 2

Engineering and Scientific Manpower Employed by Local Governments

Occupational Category	Wastewater Treatment		Sewage Collection		Design & Administration		Total	
	1971	1976	1971	1976	1971	1976	1971	1976
Engineer	1,400	1,800	1,600	2,000	600	800	3,600	4,600
Scientist	200	300	200	300	300	400	700	1,000

TABLE 3

Engineering and Scientific Manpower Employed by State Governments

Occupational Category	FY 1971 Staffing	FY 1976 Projections
Engineer	1,500	3,900
Scientist	600	1,600

TABLE 4

Engineering and Scientific Manpower Employed by Federal Agencies Other than the Environmental Protection Agency

Occupational Category	FY 1971 Staffing	FY 1976 Projections
Engineer	2,300	3,200
Scientist	2,300	2,700

TABLE 5

Engineering and Scientific Manpower Employed by the Environmental Protection Agency

Occupational Category	FY 1971 Staffing	FY 1976 Projections
Engineer	600	900
Scientist	600	900

increases by 1976 are shown in Table 5. Although a 50 percent increase is shown in both the engineering and scientific occupational categories, the total increase of 300 in each category is a relatively small number of personnel being trained for the field of water pollution control. As stated earlier, the new graduates' chances for employment with the federal government are much better with agencies other than the Environmental Protection Agency.

An increase of 33 percent is anticipated for operators employed by federal agencies, and the need for technicians is expected to increase by 19 percent (Table 1).

THE PRIVATE SECTOR

Consulting Firms

Current and projected manpower needs of consulting firms have been estimated based on a detailed survey reported by Middlebrooks, et al. (3). Unless otherwise noted the information in this section has been abstracted from this reference.

Consulting firms account for a significant part of professional employment in the water pollution control field, and they utilize a wide variety of professional skills. Employment data for 1970 and 1971 are by occupational category in Table 6. Consulting firms reported fairly adequate manpower supplies in 1971, as evidenced by low vacancy rates. Among professionals, 5.2 percent of all full-time positions were vacant, while the figure for technicians was 4.1 percent. The professionals employed in consulting work had impressive academic qualifications; 95.5 percent had at least a B.S. degree, and 23.7 percent had graduate degrees. Over half of all professionals were registered. Among sanitary engineers, the figure was 47.8 percent.

Projection of future manpower needs in the consulting field is complicated by the importance of federal expenditures in this area, especially in the form of aid to communities constructing wastewater treatment plants. Because the pattern of federal spending in this area has been very erratic recently, projections based on two federal aid levels were made. These are shown in Table 7 for professionals, and in Table 8 for technicians.

Other Areas

Within the nongovernment sector, consulting firms are the major employers of scientific and engineering manpower, but industry, education and water pollution equipment manufacturers are also significant. Projections of manpower demand in these fields, as well as for consulting, are shown in Table 9.

TABLE 6

Number of Employees in Various Occupational Categories

Professional and Technical Staff	Total # of Employees in Each Category Doing Water Pollution Work During October...				Number of Firms Reporting Employees in Occupational Category
	1970		1971		
	Part-time	Full-time	Part-time	Full-time	
PROFESSIONAL STAFF	1,669	7,004	4,464	7,624	-
Water Resources Planners	140	370	395	435	226
Civil/Sanitary Engineers	330	2,662	1,963	2,950	725
Civil/Structural Engrs.	159	837	178	857	438
Civil/Soils Engineers	55	191	74	188	195
Mechanical Engineers	198	578	628	594	421
Electrical Engineers	260	446	443	465	334
Chemical Engineers	28	133	43	155	133
Architects	154	250	345	251	173
Geologists	26	73	31	78	88
Hydrologists	26	79	31	91	86
Biologists	13	17	16	29	38
Municipal Engrs./Planrs.	54	348	62	375	218
Economists	13	48	17	52	64
Landscape Architects	42	54	9	55	70
Surveyors	126	756	140	870	406
Systems Analysts	14	90	16	87	83
Chemists	31	72	43	92	90
TECHNICIANS	1,115	6,508	1,263	6,859	-
Draftsmen	566	3,390	630	3,461	798
Instrumentmen	89	581	106	604	348
Field Crew	273	1,128	318	1,172	421
Computer Programmers	41	147	43	162	162
Inspectors	146	1,262	166	1,460	444

TABLE 7

Projected Professional Manpower Requirements for the Consulting Industry According to Occupational Category

Professional Staff	Projected Manpower Requirements			
	At Present Levels of Fed. Aid		At 2 x Present Fed. Aid	
	1972	1976	1972	1976
Water Resources Planners	777	962	1,052	1,666
Civil/Sanitary Engineers	5,540	7,222	7,177	10,474
Civil/Structural Engineers	1,761	2,397	2,171	3,181
Civil/Soils Engineers	513	709	670	920
Mechanical Engineers	1,323	1,863	1,676	2,526
Electrical Engineers	1,108	1,493	1,391	1,994
Chemical Engineers	355	668	519	1,056
Architects	493	641	604	794
Geologists	211	281	264	394
Hydrologists	219	366	296	525
Biologists	97	190	156	296
Municipal Engrs./Planners	653	932	896	1,316
Economists	107	170	151	248
Landscape Architects	155	202	190	323
Surveyors	1,108	1,425	1,377	1,936
Systems Analysts	168	269	226	386
Chemists	189	326	260	434
Totals	14,777	20,116	19,076	28,469

TABLE 8

Projected Technician Manpower Requirements for the Consulting Industry According to Occupational Category

Technicians	Projected Manpower Requirements			
	At Present Levels of Fed. Aid		At 2 x Present Fed. Aid	
	1972	1976	1972	1976
Draftsmen	5,957	8,226	7,701	11,305
Instrumentmen	1,130	1,581	1,484	2,032
Field Crew	1,833	2,659	2,660	3,864
Computer Programmers	403	536	495	724
Inspectors	2,644	3,611	3,755	5,406
Totals	11,967	16,613	16,095	23,331

TABLE 9

Engineering and Scientific Manpower Engaged by Non-Government Employers

Employer	Manpower Engaged	
	1971	1976
Industry	3,700	12,100
Education	700	700
Equipment Manufacturers	2,000	2,400
Consulting Engineers	7,600	11,800
Totals	14,000	27,000

Industrial firms are expected to represent the largest increase in manpower utilization in the water pollution control field in the nongovernment sector. An increase of over three times the number employed in 1971 is expected to be needed by the various industrial firms throughout the United States to combat water pollution. The educational needs are expected to remain roughly constant, and equipment manufacturers are expected to increase their employment by approximentaly 20 percent. However, a more recent estimate (4) indicates that this increase for equipment manufacturers is very conservative, and a more pronounced increase will probably occur between 1971 and 1976 as shown in Table 9. Consulting engineering firms are expected to increase their employment approximately as shown in Table 9, but this increase will vary considerably with the amount of money that is spent by industry and local governments in combating pollution during the next five years. A survey of consulting engineering firms completed in 1972 indicates that the estimate shown in Table 9 could more than double if additional funds are made available for construction activity (3). The overall increase in manpower needs in the water pollution control field in the nongovernment sector will at least double between 1971 and 1976; and, if funds become available and standards are enforced as planned, the increase could be as large as three times the number of personnel employed in 1971.

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THE GOVERNMENT'S ROLE IN WATER QUALITY EDUCATION

Wesley O. Pipes

INTRODUCTION

This is an assigned topic, not one which I selected. Even as an assigned topic, it would be presumptuous for a college professor to say what the government's role in water quality education should be. This will be a discussion of what water quality education is, some viewpoints about what the government's role should be, and some apparent problems. At the end of the discussion I will make a couple of suggestions about what the government's role might become.

WATER QUALITY EDUCATION

There are many possible objectives for water quality education, but they can all be placed in the two large categories of general education and technical education. General water quality education includes all those programs whose objective is to inform the public; that is, those people who are not now and are not planning to be employed in the water quality industry. Technical education includes those programs which are intended to prepare the students for employment in the water industry. Technical education would also include continuing education for people already employed in the water industry. The water industry would include not only those people working for water departments and sanitary districts but also those people working for other industries, governmental agencies, and academic institutions who are primarily concerned with water quality problems.

Everyone who drinks water and flushes wastes should know something about water quality problems. The word "problems" is used here because of the general education programs of the last ten years. Water quality used to be considered to be an asset but now it is viewed as a problem. Whether this change from a positive to a negative view is beneficial or not is debatable; however, the fact that the

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viewpoint has changed so drastically in such a short period of time is evidence of the effectiveness of the general water quality education problems. Anyone who wants to find out about water quality has many alternative sources to select from and the difficulty here is an overabundance of information, much of which is either incorrect or misleading.

Since there is an overabundance of general information about water quality problems, public pressure to do something about the problems has been created. I believe that it is demonstrable that there are inadequate numbers of technically educated people in the water industry to solve all of the water quality problems which the public has been educated to perceive. However, manpower needs in this field is the subject of another paper at this symposium.

Water quality does not exist in any abstract sense but in relation to existing or potential uses of the water. The uses people wish to make of the water include not only the various categories of water supply but also many _in situ_ uses such as recreation, navigation, power production, etc. Thus, the quality of water is described not only by the chemical constituents and biological organisms in the water but also by the physical characteristics of the water body such as sediment type, depth, area, surface elevation, connection with other water bodies, and others. What this says is that there is no clear way to separate the fields of water quality and water resources.

In recent years, there has been in academic institutions a clear tendency to separate water resources education from water quality education which is recognized as a part of environmental engineering education. This may be due in part to a tendency of the dam builders and stream channelizers to feel defensive about the criticism they receive from environmentalists, but I believe that it is more due to the existence of two different federal agencies with different pots of money. If the Public Health Service had any money to support education and research in drinking water quality there probably would be a third organization related to water quality at most universities.

Water quality education and water resources education are really two different approaches to the same field. In this general view, the field of water quality includes not only chemistry, biology and process engineering but also hydraulics, hydrology, geology, some types of structural engineering and economics. Problem solving and management techniques, loosely lumped together as operations research, are also a popular educational component of the field. It is probably unreasonable to expect that anyone would be educated in all of the disciplines which are related to the applied field of water quality, but it would be sound educational practice to assure that someone specializing in one part of the water quality field be aware of the overall field and knowledgeable about what types of educational backgrounds his colleagues need.

Personnel in the water industry work at various types of jobs and at various professional levels. The types of jobs include engineering, scientific studies and analysis, management, operation, maintenance, and technical assistance. The educational levels range from operators with a high school education plus some special courses and on-the-job training through B.S. and M.S. level scientists and engineers, to the Ph.D. level. It must be recognized that the type of education a person has does not always correspond to the type of job he has nor does the level of formal education always correspond to his job level. The situation which exists is a flexible one in which personnel in the water industry have the opportunity to switch from one type of job to another and to advance to higher levels by self-education or continuing education courses.

VIEWS OF THE GOVERNMENT'S ROLE

"Government" as used herein refers primarily to the U.S. Federal Government. However, it should be noted that state and local governments have traditionally assumed major roles and major responsibilities in both education and the water industry. The federal government's role in the water industry has been, in large part, regulation of other governmental agencies. Likewise, the federal government's role in water quality education has been, in large part, attempting to help educational institutions supported primarily by state and local government. Many of the agencies on the receiving end of the government's role are themselves governmental agencies.

The federal government has long ago assumed a major role in public education, by way of making many reports, pamphlets, books, and other forms of information widely available either free or at very low cost. The Department of Agriculture has done an excellent job in this regard for many decades as has the Public Health Service. In addition to providing information about water quality problems, the federal government has organized seminars and workshops directed toward public education and assisted and encouraged public interest groups in many other ways. As far as I can ascertain, the prevailing view, with some reservation, is that this part of the government's role is beneficial and should continue.

The reservation about the government's role in general water quality education is related to truthfulness. The question of technical accuracy is not an issue here. The government's technical accuracy in water quality matters, although not perfect, is at least as good as that of the average textbook in the field. The truthfulness here is related to presenting only one side of an issue, to selection of which technical facts are presented, and particularly to how words are used.

The government has become a determined advocate of wastewater treatment. In an adversary situation it is common practice to present the particular set of facts which emphasize only one side of the issue and to twist the meaning of words to fit a particular point of view. The public learns more of what is said in court or in a Congressional hearing rather than what the technical facts are. As an illustration, one of the unfortunate results of this situation is that the word "pollution" has a completely different meaning than it did ten years ago and is really no longer useful for didactic purposes.

The truthfulness of the government has been a matter of considerable public interest for the past two years. The prevailing view seems to be that the government should be truthful, but the evidence indicates that this may not be a realistic goal. I am not sure if there is any documentary evidence prior to King David, but there is at least a 5000 year record which establishes governmental lying as a firm tradition. Henry VII did a fantastic hatchet job on Richard III and the English public believed him for over 400 years. Of course, he had some unwitting help from Sir Thomas More and William Shakespeare. The writers who perpetuate government lies these days are not that good, nor are they as successful either. Truth is the daughter of time, not of governments, and it is unreasonable to expect a sow to give birth to a lamb.

The government has assumed an important role in technical water quality education at all levels. This role has included providing technical information and educational materials for use in courses, offering courses or parts of courses, supporting the organization and development of educational programs, sponsoring seminars and conferences, evaluating programs, and providing financial support for students. It is not really possible in this paper to go through an analysis of all these aspects of the government's role at all the educational levels, but it is possible to comment briefly on some of these aspects of the government's role as they affect university education.

The government's role in providing technical information has been an extremely beneficial one. I use many government publications on the biological and chemical aspects of water quality most of which were produced several years ago in laboratories which are now a part of the U.S. Environmental Protection Agency. The only problem is that some of them are becoming a little outdated and they need to be revised. There have been some complaints about the Technology Transfer Manuals but they are still useful documents for educational purposes. It is clearly in the public interest for the government to continue the activity of assembling technical information about water quality and making it available.

The government's role in evaluating educational programs has also been extremely beneficial. A site visit from outside consultants is a great deal of help in 1) reminding administrators that the program exists, 2) motivating the formulation of educational objectives and recognition of problems, and 3) finding out what is being done in other programs. Unfortunately, a site visit just for the sake of a site visit would not be much help. It is the fact that the outcome of the site visit may determine whether or not a grant is awarded which really gets things moving. One of the most unfortunate and least recognized consequences of the proposed phase-out of government support of graduate programs in the field of water quality will be the loss of the site visit effect.

Since this symposium is government sponsored I don't really feel very free about commenting at length about the government's role in sponsoring symposia and conferences on environmental education. However, my disappointment in some previous government supported conferences is clearly on record. There are too many symposia and conferences on the various aspects of environmental education, and they accomplish too little. The fact that they accomplish too little is, however, more the fault of those of us who attend the conferences rather than of the government that provides the support.

It is clear that the majority viewpoint of those of us on the receiving end of the government's role in water quality education is that government support for students in our programs should continue and preferably be increased. This is such a strong viewpoint that a separate argument is made in the next section of this paper. Here, it will be noted that there are a significant number of educators in the water quality field who express the viewpoint that we all will be better off when the government gets out of the support business entirely. The reasons for this minority viewpoint are fear of oversupply of personnel in the water quality field, the effect that government grants has on the administrative structure of universities, and the belief that government support has maintained some low quality programs which wouldn't have been able to make it on their own. My own belief is that there is no danger of our even meeting the manpower needs in the water quality field, that the administrative pettifoggers have already taken over the universities and they won't go away just because their reason for coming in is removed, and, given the manpower needs, it is better to try to maintain and upgrade the lower quality programs than to let it flounder into oblivion.

One of the obvious roles for the government in water quality education is planning. The EPA does have an Office of Education and Manpower Planning. No one from that office has ever tried to tell me or, as far as I know, any of my colleagues what to do. Actually, the tendency has been more in the other direction; we have tried to tell them what to do. We haven't been any more successful in getting them to do what we tell them to do than they would be if they tried to tell us what to do. However, it could be quite helpful if they would at least tell us what they are planning to do.

Planning in the sense of trying to tell everyone what to do never seems to work out very well. However, planning can be very helpful if it is carried out on a service basis. Accurate information on and projections of manpower needs and educational needs in the water quality field would be of great benefit. Plans which would show the alternate methods of meeting these needs and identifying bottlenecks could make life a bit easier for all of us in the educational field. There is a very important role in planning to meet manpower and educational needs which the government could take.

GOVERNMENT SUPPORT OF WATER QUALITY EDUCATION

This argument has been made so many times in the past that it has become almost pro forma. It will only be outlined here for the sake of completeness.

Governments at all levels have accepted the major responsibility for all aspects of water quality. Recently, the federal government has made an attempt to become dominant in the water quality field (and largely succeeded). Assuming this responsibility implies that the federal government will take whatever reasonable action is necessary to meet the stated national goals for water quality. One of the requirements for meeting these goals is a much larger number of well-educated technical personnel in the water quality field at all levels.

Government at all levels has also accepted the major responsibility for education. It is not clear whether or not the federal government is trying to become dominant in education. However, it is clear that much of what educators do these days is conditioned by federal actions. It is also clear that state and local governments have just about arrived at the end of their resources which can be used for educational purposes. If there is to be expansion of educational efforts in any field it will have to come at the expense of losing other educational efforts or will have to have support from federal tax monies.

Both water quality and education are resources which cannot be equitably purchased in the market place. The government takes responsibility for these programs under the constitutional directive to provide for the general welfare. They are both programs which are analyzed and justified according to the principles and methods of welfare economics. The old benefit/cost ratio method of welfare economics has been widely discredited and is being replaced by something like the environmental impact assessment method. The attempts to assess the environmental, social, and economic impacts of the government's decision to phase out support for students in the water quality field have so far been partial and informal but they all indicate that the impacts will be decidedly negative.

There are something over 2000 universities and colleges in the United States. Of these, 225 or approximately 10% have engineering programs accredited by the Engineering Council of Professional Development. About half of these engineering schools offer graduate work in the water quality field. These programs have a maximum capacity of turning out from 2000 to 3000 engineers with a masters degree in the water quality field each year but are producing less than 1000 per year at present. It is evident that the limiting factor for these programs is the supply of well-qualified, entering graduate students. Providing adequate financial support for 2000 to 3000 masters students in water quality would not solve all the problems but it would break one large bottleneck.

SUMMARY

I would not want to assume the responsibility for telling the government what to do in water quality education any more than I would stand for the government telling the educational institutions what to do in this field. However, on the basis of past history, it is possible to outline some of the things which the government might do.

The government has taken a leading role in general water quality education by providing information and supporting public interest groups. This role has been mostly beneficial and should continue. The government could be more careful about trying to present a balanced viewpoint, but the historical evidence suggests that this is too much to expect.

The government has also taken a leading role in technical water quality education at all levels from vocational training to doctorate education. This role has consisted of providing information and educational materials, providing organizational and financial support for new programs, supporting symposia and conferences, providing some degree of planning and coordination for the overall field, evaluation of programs, and providing support for students in the programs. I am sure that the government will continue to have some important role in water quality education in the future, but it is not clear what the government is planning to do. From my viewpoint, what the government has done in the past has been extremely beneficial to water quality education and I would hope that they would continue to do the same types of things. I have only a couple of suggestions to make.

One suggestion is that the government should make a more determined effort to recognize the side effects of their support on academic institutions. Every time that the government sets up a new program or agency with funds for support of educational programs, many universities will set up new organizations specifically designed to get some of the federal money. Unfortunately, even after the federal support dries up, the administrative organizations in the universities don't disappear; they just look for something else to do. In this field where we have separate water resources funding and water quality funding, many universities have two different administrative organizations and what should be one field is split into two. This impedes the educational process. It seems that two sources of federal support should only double the amount of paperwork. However, each university organization has to be administered and each administration in itself doubles the paperwork. So we end up with about four times as much paperwork as is really needed. If the funding sources could be lumped together, then the university administrators could be lumped into the same organization and spend more of their time creating problems for each other rather than creating problems for the faculty. I am realistic enough to know that governmental agencies have their own problems and it is highly unlikely that they would reorganize to accommodate academic institutions. However, if the government agencies were only aware of what side effects they have on academic institutions when they do reorganize it might be of considerable benefit.

The other suggestion is that there could be a major governmental role in planning for water quality education. I don't mean planning in the sense of telling everyone what to do. I mean planning in the sense of collecting information about what is being done and what needs to be done, identifying bottlenecks, and generally improving communications. This type of planning service is badly needed in the field of water quality education and could be of considerable benefit both to the educational institutions and to the government agencies.

WATER QUALITY EDUCATION

Sumner M. Morrison

It is a distinct pleasure to participate in this round table discussion on the role of government in the area of water quality education. As a microbiologist with almost 35 years of interest and activity in water quality problems, as well as intermittent interests in other areas, I believe I exemplify the results of government support of water quality education. Were it not for the far-sighted public support of education in what used to be called "sanitary microbiology" by the Public Health Service in the 1940's and 50's, by a series of short-stand agencies in the 1960's and by the EPA for the past few years, I would not be on this program sharing time with the sanitary engineers and the other disciplines that are represented in the three days of symposium. I must emphasize that although my academic role has been enhanced and made more productive by federal support funds, my personal position and salary have never been dependent upon these funds.

Although it was probably not the avowed purpose of the graduate education support programs to develop interdisciplinary activities (a term which was almost unknown in university circles up to recent times and which is still considered a sophisticated four-letter word by many academic administrators), this is exactly what has happened, to everyone's gain. My work with and access to the engineers both on my campus and nationally, have been rewarding and beneficial, not only to those of us on University faculties, but to our students, to governmental agencies at all levels, to industry, and ultimately to the taxpayer, the consumer. With water pollution or water quality as a focus, government support programs for graduate education have created the link for communications among the engineers, biologists, chemists, political scientists, lawyers, planners, managers and all the other disciplines that are needed to make for viable progress in meeting our goals in the area of water quality. This type of communication needs further development. The communication mechanism evolved before the goals were delineated. Now that the people, through their Congress, have clearly

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spelled out the goals and timetables, there is a greater need for governmental stimulation of academics, not less as has been decreed in high places.

We in academics have been notoriously deficient in the area of "horn-tooting," better known today as public relations or image-making. There really did exist ivory towers (usually in the technical fields they were hot, steamy, smelly laboratories in a basement of an old building) in which there developed the basic concepts of pollution identification, the effects of pollutants and the control of these polluting materials, with almost no visibility by the public. The public knew of our football teams, they saw the pretty female cheerleaders and heard of our champion goldfish swallower. For the most part the technical output of the campus was invisibly handed over to the private and public sectors of our nation with almost no charge.

World War II shook up the nation, and everyone was grateful for the hidden talent and activities of the Universities. However, we drifted back toward our lethargy, although important policy decisions were made in 1950-51. International events of the late 1950's brought us out of the ivory towers into the forefront of our burst of national energy into modern technology, led by the space program. Our government literally poured funds into the support of technologically-oriented students, facilities and programs. The euphoria did not last long; again international events plus several other factors made the campus an arena like earlier civilizations in which the Christians played the lions. Things like public buildings, property rights, motherhood, bathing, religion, military duty obligations, etc., that administrators and faculty held sacred, suddenly were under attack by our students. Strangely enough, out of this destructive and disruptive era came the driving force of our environmental movement of the late 1960's as well as a giant step towards maturity in many of our universities.

I would like to read a quotation from a recent address by Philip Handler, President of the National Academy of Science.

> We will continue to witness, on campus, multidisciplinary approaches to societal problems. Certainly, no institutions are better endowed in the mix of talents required. But equally certainly, if the University chooses to become intimately involved with the solution or management of major societal problems, it opens the door to its politicization, to attack from within and without. I would find it horrendous to think that such efforts might be at the expense of the classical function of the University as the repository and generator of scientific understanding of man and his universe. The historical accident by which the American University came to serve this role--as compared with, for example, the independent research institute system of the socialist nations of Eastern Europe--has proved to be extraordinarily fruitful and successful.

Political leaders, in their usual myopic manner (a mental attitude stimulated by facing the voters at reelection), reacted to the campus unrest with changes in attitudes and policies about support of students in higher education. Unfortunately, the good have been punished with the bad; essential programs have been abolished along with those that were badly planned or managed.

We hear today statements of policy which indicate that the people making them do not wish to be bothered with their knowledge of history. Ideas that the government should not be involved in supporting students in higher education run counter to one of the best bills that ever came out of Congress--the Land Grant Act of over a hundred years ago. Tuition-free institutions were established to train people to feed, clothe and house our nation. It worked; however, tuitions certainly are no longer free. Three of the four academic types on this round table discussion are associated with schools that were founded and nourished by this Land Grant dowry. Many, many, many times in recent history, government has provided the funds to support schools and students where the national welfare was to benefit.

Then we hear the complaints that federal funds have led to an unbalanced production of personnel--not enough aerospace scientists and engineers at the start of the Space Program and too many when the program was wound down. I am sure I do not have to elaborate for people in the state of Washington. Was the fault in our academic system or among the bureaucrats in federal and state governments, industry and even universities? The parts of the program that had public appeal, I believe the word is sex-appeal, were moved ahead very successfully, but the "dull" part that had to do with manpower (I should say peoplepower) planning, projections and training were left to chance, supply-and-demand. A lot of potential leaders were diverted in the middle of their training and lost to such fields as environmental engineering and science by this crisis-type management of education for our tremendous pool of bright young people in specialized fields.

For the good of the nation we must not let this hit-and-miss approach to providing new talent to our water quality control programs prevail. The same, I am sure, can be said for our other environmental programs such as air, energy, pesticides, radioactivity, toxic materials, solid waste, etc. Our streams are certainly an interstate matter and similarly are the specialized graduate programs in water quality control. This latter point is true, in spite of the table-thumping speeches by political figures at the state level and by some university governing board members. It follows that the responsibility for manpower planning for the near and distant future should also be interstate in nature. This obviously means that it has to be done at the federal level.

Done thoroughly, accurately and on a continuing long-term basis rather than on a crisis criterion, a very small portion of the total federal dollar commitment in pollution control programs would assure a steady, balanced supply of new young leaders from our academic institutions. To meet the goals and objectives of the water pollution control laws already on the books requires students with a specialized type of academic experience, not just a short-course. As we move ahead, new criteria and laws requiring even greater degrees of sophistication in design and analysis will evolve. This makes it imperative that we educate now the leaders who will inherit the responsibilities when a lot of us will have gone fishing.

Perhaps this sounds like public support of an elitist group of students, a concept that is in political disfavor these days. However, if it is true that we need leaders, you cannot produce them with a "welfare" program approach. You start with the mentally rich and make them richer, productively and, incidentally, financially. Their repayment to society will be the technology, the stability and leadership and again incidentally, the financial return (taxes) they will provide.

Appropriate management procedures can assure that potential leaders in the water quality area, no matter where they are in our society or what the physical characteristics of their personal being, will be found and supported. More difficult, obviously, is how these people can be identified, stimulated and directed earlier in the education process, well before graduate school.

Perhaps as a speaker on this panel I should have directed my remarks to my views on the mechanics of governmental activities in the education of water quality personnel. Rather, I have chosen to direct my remarks to the history, tradition and precedent of governmental support of specialized training, where the health, safety and welfare of the nation is at stake. This is especially important where federally enacted laws are imposed upon the individual states and the traditional free-choice concept of educating specialized personnel just does not work.

After many years of working with EPA and its predecessors in the area of manpower development I am convinced that the mechanics of identifying and supporting programs becomes an easy process if the appropriate long-term commitments are made and proper planning done.

My recommendations include the following with EPA as the appropriate agency to perform the task:

1. A continuing manpower study group with adequate expertise and representation so that its results are credible and not political, self-serving, job protective, etc. Above all it should not be done by the lowest bidder. This group must make short as well as longer term projections of numbers, types, levels, disciplines, specialties, geography and other characteristics of the personnel needed.

2. A visible commitment at policy-making levels that educational support will be available to meet the manpower needs and recommendations. Billions in current construction, and above all, new and better methods of attack of environmental problems in the future, cannot be left to chance availability of human talent.

   A philosophy of educational support should evolve which realistically assigns the necessary dollars to develop the best potential talent and the facilities and staff to do the job. Mediocrity in all aspects of manpower development must not be tolerated. Dependence upon dedication and loyalty will not work forever.

3. A manpower development office functioning with continuing inputs from all segments of the agency, especially research and development; a communication link with each state water pollution agency and, of course, EPA regional offices; and most important, direct participation by the academic community. Unilateral decision making will just not get the proper response from those people who must devote their professional lives to educating the high level types of young talent I personally feel we need.

A few months ago my suggestions might have been called politically naive. Events since then indicate that it is time for government to get out of its ivory tower and talk to the people who do the work and foot the bill.

Session 7

TRAINING OF WATER SUPPLY AND POLLUTION CONTROL PLANT OPERATORS IN IOWA

E. Robert Baumann

INTRODUCTION

Historically, man has suffered from the improper treatment of his water supply and from the disposal of his wastes. We have learned much about water and waste treatment and have spent billions of dollars to construct plants to effect an improved environment. Yet, it is doubtful that there is a single wastewater treatment plant in Iowa or in the nation that is not inadequate in some way. Consequently, optimum operation of what we now have is of primary concern in prevention of stream pollution and the resultant protection of our environment. It is noteworthy that concern for effective plant operation has been considered of prime importance in Iowa for many years, as indicated by the following quotations:

--Anson Marston, Iowa State University's first Dean of Engineering and creator of the first Engineering Experiment Station in the U.S., said in 1916--"How to secure proper care and operation of our sewage disposal plants is the most important sewage disposal problem in Iowa at the present time and is much more important to the sanitary engineers and to the municipalities of the State than is activated sludge or any other promising scientific development in the art."

--Al Wieters, Chief Engineer of the Iowa State Department of Health said in 1940--"One of the greatest needs in stream pollution control in Iowa at the present time is to secure improved operation of existing plants."

--R. J. Schliekelman, then Executive Secretary of the Iowa Water Pollution Control Commission, said in 1968--"Construction of wastewater plants is only part of the solution to the problem of water pollution control...we still have a serious problem because of insufficient trained operators, low salaries and, in small towns, too little time spent at the treatment plant."

It is time each state took definite, planned steps to provide the opportunities for training operators with all the levels of skills needed to make our water and pol-

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lution control facilities effective in protecting our environment.

A sound basis has been developed for establishing such a training program for operators of water and wastewater treatment plants. Through study results already reported to EPA (1, 2), task analyses, job profiles, and many other facets of operating a conventional wastewater treatment plant have been identified. Black and Veatch Consulting Engineers have directed their attention to plants with capacities over 1 MGD (1). Personnel here at Iowa State University have directed attention to plants with capacities less than 1 MGD (2). The Center for Manpower Research and Training at North Carolina A & T State University has recently published "Manpower Requirements for Wastewater Collection Systems in Cities and Towns up to 150,000 in Population." (3) A recent guide to individuals engaged in manpower planning has been published by the Environmental Protection Agency (4). John A. Voegtle has recently proposed a "Career Development Guide for Wastewater Facility Personnel." (5) He proposes a means for defining various jobs in wastewater treatment plants to provide a basis for uniform certification and training of operations personnel. The proposed Career Development Guide (CDG) involves several important new concepts which may or may not be feasible in states with a preponderance of small-size, one or two-man plants, such as we find in Iowa. For example, the CDG suggests:

--The existence of entry-level positions (for professional career development) exclusively in the large facilities, and the movement of qualified persons from the larger to the smaller facilities.

--The development of an in-plant training and educational capability in all large facilities and some medium-size facilities.

--The certification of levels of professional achievement rather than skills and knowledge as related to a specific job.

These CDG concepts will require special consideration in developing a state planning program for operator training.

In effect, the CDG provides for the separate identification of training and educational needs. The CDG views the basic role of the two- and three-year colleges as educational and that of the trade and vocational-technical schools as training. At present, all the required educational and training programs do not exist today in Iowa and those that do exist are not properly structured to support a career development ladder essential for good plant operation. For that reason, personnel of Iowa State University, the University of Iowa, and Kirkwood Community College are engaged in the development of a "State Pilot Planning Program for Training Water and Water Pollution Control Plant Operators" in Iowa.

NEED FOR A STATEWIDE TRAINING PROGRAM

Public Law 92-500, the Water Pollution Control Act, has created by federal law several different municipal and industrial wastewater treatment programs. If these programs are to be successful, and the goal of water pollution control is to be achieved, an adequate staff of trained personnel must be made available. The program needs created by PL 92-500 include the following:

--Operation and maintenance of municipal water supply and pollution control plants.
  Hire/train operators, entry/upgrade levels.
  Train supervisors/managers.
  Train laboratory/maintenance personnel.
--Operate a state permit compliance and assurance program.
--Operate a state operation and maintenance technical assistance program.
--Develop area-wide collection and/or treatment schemes.
  Need personnel for planning/management.
--Operate the state/municipal agency program for management of PL 92-500 programs.
--Operate a state water quality monitoring/surveillance/analysis program.

In view of our involvement in statewide operator training and engineering education, we were approached by Environmental Protection Agency officials and asked the question, "does Iowa have the self-sufficiency to take over completely, without federal support, the training program needed to meet PL 92-500 manpower requirements?" In recent years, it has become apparent that the EPA views itself as an ENFORCEMENT agency, and, in fact, plans to transfer all training activities over to the states if they are able to meet the training needs. In our study, we were asked to look at the plant operator training needs in Iowa and our ability to meet them. That is the reason I'm going to confine the discussion to Iowa's ability to meet training needs.

HISTORY OF OPERATOR TRAINING IN IOWA

Early History

Iowa State University was created under the provisions of the Morrill Act in 1868 as the first Land Grant College in the United States. The first engineering class was graduated in 1872. As a result of planning by a Burlington, Iowa, water treatment plant operator, a number of operators of water plants on the Mississippi River met in St. Louis in 1888. From this meeting, the American Water Works Association has evolved.

The first technical publications involving wastewater treatment in Iowa date from 1898 when Anson Marston, Dean of Engineering at Iowa State University, became active in water and wastewater treatment plant design. The first Engineering Experiment Station in the United States was created in 1904 at Iowa State University to conduct an active program of research in both highway work and wastewater treatment. From 1904 to 1920, technical information on wastewater treatment plant design and operation was presented yearly to engineers at the annual meetings of the Iowa Engineering Society, founded in 1889. In the period from 1918 to 1920, an annual series of three-day conferences-short courses was developed and carried out by the Engineering Extension Service of Iowa State University "to help both new and experienced operators improve their basic knowledge of waste treatment." A similar program of conferences-short courses was initiated at about the same time by engineering college personnel at the University of Iowa "to help both new and experienced operators improve their basic knowledge of water treatment."

As a result of the annual conferences, the operators themselves recognized their deficiency in training. The low salaries and low esteem in which they were held by the citizens of their communities was of serious concern to them. During the wastewater conferences held in Ames, the subject of certification and/or licensing often came up. In 1941, a committee on "Civil Service and Certification" was formed and a report prepared. The report was not presented to the conference due mainly to the travel problems developing in World War II. In 1947, a new "Committee Report on Supervised Home Study Courses and Certification of Sewage Treatment Plant Operators" was prepared and presented. The report was printed, distributed, and adopted by the conference in October, 1947.

The main goals of the "home-study" or correspondence courses were to "take the school to the operators" and to provide "on-the-job training." A series of five correspondence courses, each with 12 individual lessons, was prepared:

1. Fundamentals: septic tanks and sand filter treatment.
2. Imhoff tank and conventional trickling filters.
3. Separate sludge digestion and high-rate filters.
4. Activated sludge treatment.
5. Industrial wastes and other special problems.

Course 1 was launched with enthusiasm in January, 1948, and promptly failed. Of more than 60 who enrolled for the course, only 14 ever completed course 1 and took the final examination. Two years were spent in attempts to make the program viable, but by the end of 1949 the program was dead.

Licensing Bills

By the end of World War II, the annual conference for wastewater treatment plant operators had pulled away from Iowa State University and was now sponsored by the Iowa Water Pollution Control Association (then, the Iowa Sewage and Industrial Wastes Association). The Association sponsored a bill in both the 1949 and 1951 Iowa Legislature calling for mandatory licensing of sewage works operators. The bills never left committee, but friendly legislators suggested that we pioneer with "voluntary certification" before we hit the legislature again. In the fall of 1952, the Association adopted a voluntary certification program and gave the first certification examinations in the spring of 1953. The program was an instant success, creating both an intense interest in the Association and a strong demand for more education.

As a result of the very favorable experience in voluntary certification of pollution control plant operators, the Iowa Section of the American Water Works Association adopted in 1958 the "Iowa Voluntary Certification Program for Water Works Operators." The Section also found that training was an essential necessary adjunct to the certification program.

The voluntary certification programs were so effective in upgrading plant operator interest in his job and in his willingness to improve his knowledge that both associations sponsored a mandatory certification program in the Iowa legislature. Operator certification became mandatory in 1965. Once more, there existed an increased demand for more and improved training. Training approved for certification credit is summarized in Table 1.

The Basic Training Courses

With the advent of voluntary certification of wastewater treatment plant operators in 1953, the Iowa Water Pollution Control Association voted to take a new direction in operator training. A committee consisting of operators, consulting engineers, and professors from both universities considered various proposals for types of meetings, locations, material to be covered, instructors, and fees. A new approach to operator training in Iowa was evolved:

--First, it was felt that the greatest need was at a beginning or basic training level for operators with particular emphasis on the Grade I and II operator.

--Secondly, it was felt that the course should be made as conveniently available to the operators as possible.

As a result, a program of "basic training courses" was developed. The state was divided into six training areas (Figure 1) generally following boundaries of the existing State Department of Health regions, now the Department of Environmental Quality regions. Figure 1 indicates that in 1973 there were 561 water pollution

TABLE 1

Water Supply and Wastewater Plant Operator Certification

Continuing education opportunities available for which credit may be allowed:

A. Established training courses which are supported by fees and are strong continuing programs:

Course Title	Location	Conducted by	Frequency (No./year)	Duration (days)
1. Basic Training (water supply)	Cherokee	ISU*	1	8
	Belmond	ISU	1	8
	Manchester	SUI**	1	8
	Washington	SUI	1	8
	Indianola	SUI	1	8
	Atlantic	ISU	1	8
2. Basic Training (wastewater)	Cherokee	ISU	1	8
	Belmond	ISU	1	8
	Manchester	SUI	1	8
	Washington	SUI	1	8
	Indianola	SUI	1	8
	Atlantic	ISU	1	8
3. Advanced (water supply and wastewater)	SUI	SUI	1	3
4. Shortcourse (water supply and wastewater)	SUI	SUI	1	2
5. Water Resources (water supply or wastewater)	ISU	ISU	1	2
6. Laboratory Symposium (water supply and wastewater)	State Hygienic Lab	SUI	1	1
7. Fluoride Training	Des Moines	State Hygienic Lab	Variable 3-4/year	1
8. Laboratory (wastewater)	ISU	ISU	1	3
9. Great Plains Design (wastewater)	Omaha, Neb.	Iowa-Neb. WPCA	1	1

* Iowa State University
** University of Iowa

TABLE 1 (con't)

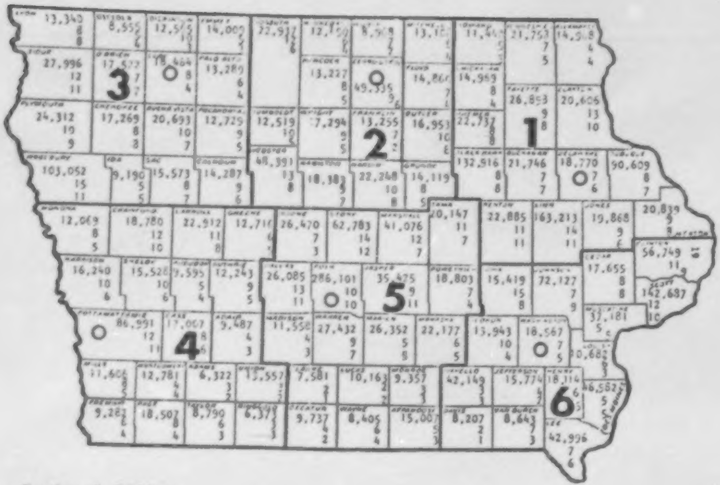
B. Training courses which are relatively new, supported by federal training grants, and of questionable duration.

Course Title	Location	Frequency (No./year)	Duration (days)
1. On-the-job Lab Training (wastewater)	Local (by Kirkwood College)		
2. On-the-job Operator Training (wastewater)	Local (by D.E.Q.)		
3. Lagoon Operation	Local (by D.E.Q.)		

C. Technical Conferences

Conference Title	Location	Frequency (No./year)	Duration (days)
1. American Water Works Association			
(a) National	out-of-state	1	7
(b) State	in-state (variable)	1	2½
(c) Regional	throughout state (variable)	6	1 ea.
2. Water Pollution Control Association			
(a) National	out-of-state	1	7
(b) State	in-state (variable)	1	2½
(c) Regional	throughout state (variable)	6	1 ea.

REGIONAL OFFICES
DEPARTMENT OF ENVIRONMENTAL QUALITY



○ Regional Office

Listed in vertical order in each county

Population (1970 Census)
Public Water Supplies (1973)
Wastewater Plants (1973)

Region	Counties	Population	Water	Wastewater (1973)
1	15	624,224	127	106
2	15	303,587	131	79
3	16	342,845	135	102
4	19	320,786	136	96
5	18	664,659	129	100
6	16	568,275	104	77

FIGURE 1

Water and Wastewater Treatment Plants in Iowa control plants and 761 water treatment plants in Iowa. An effort was made to select sites for offering courses that would be a maximum of 50-60 miles travel distance for any plant operator. It was planned that all courses be taught largely by faculty members from the two universities. The basic course was planned to provide 24 hours of classroom instruction in eight 3-hour periods followed by the giving of the certification examination in a ninth period. At first, courses were given only in the evenings, but some are now held in the afternoons.

A first, pilot course was held at Ames in the spring of 1954(6). Enrollment reached twenty and attendance averaged over 95 percent. That fall, the Association and the operators who attended endorsed the program strongly and voted to continue it (7). In 1955, three more courses were held. In the first 14 courses, 190 of 255 course enrollees became certified by completing the certification examination successfully at the end of the course. Figure 2 shows the number of courses held each year and the average attendance at each course. As of July 1, 1973, a total of 82 basic training courses had been completed with 2,096 registrations, an average registration of 26 per course. In 38 courses prior to mandatory certification, average registration was 19. In the 44 courses held since mandatory certification, average registration has been 31.

The first Water Works Operator Basic training courses were offered in the fall of 1960. Since that time, a total of 64 courses have been held with a total registration of 1979, an average of 31 per course. In 20 courses prior to mandatory certification, registration averaged 21; in 44 courses since mandatory certification, registration has averaged 36.

Since 1967, a total of six basic training courses each have been presented to water and pollution control plant operators. Three courses in each are presented by personnel from the University of Iowa and three courses in each are presented by personnel from Iowa State University. Table 2 summarizes the attendance in the courses held in 1973-73.

Laboratory Training Course for Pollution Control Plant Operators

In 1956, a laboratory training course for pollution control plant operators was initiated at Iowa State University. The course is designed to introduce operators to the basic laboratory analyses used in assessing the operating efficiency of treatment plants. Each operator gets to run the tests personally. Enrollment is limited to 24. The course is a three-day course held annually in February in the sanitary engineering laboratories at Ames. In some years when enrollment is high, successive back-to-back courses are held. A total of over 25 such courses have been held with an average attendance of 22.

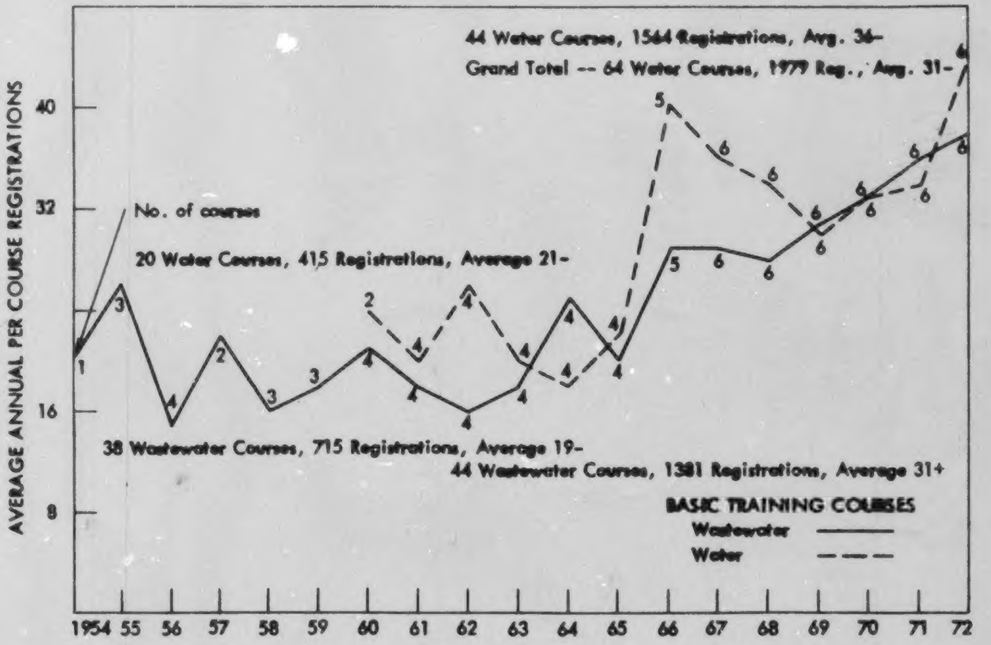


FIGURE 2

Basic Training Course Enrollments in Iowa

TABLE 2

Operator Basic Training Courses in Iowa 1972-73

Course at	Presented by	Water	Wastewater	Totals
Indianola	UI	49	32	81
Atlantic	ISU	30	24	54
Washington	UI	77	47	124
Cherokee	ISU	27	18	43
Manchester	UI	55	66	121
Belmond	ISU	31	22	53
Totals		269	209	478
Averages		45-	35-	40-

TABLE 3

Water Supply and Wastewater Plant Operator Continuing Education Requirements for Renewal of Certificates

Certificate Grade	Contact Hours	Frequency (years)
I	20	4
II	20	4
III	30	4
IV	40	4

Advanced Training Conference for Water and Pollution Control Plant Operators

In the early 1960's, an attempt was made to develop advanced wastewater treatment training courses to be taken around the state in the same manner as the basic training courses. One pilot course was held in Ames on the subject of "basic electricity for operators." Insufficient promise of an economic level of course registrations led to a cancellation of plans for such conferences.

As an alternative, the University of Iowa established an annual "Advanced Training Conference" sponsored by both the Iowa Section of the American Water Works Association and the Iowa Water Pollution Control Association. Courses are developed which contain information of interest to both water and water pollution control plant operators and are pointed at the needs of Grade III and IV operators. Each conference is given once and involves a three-day program with 21 hours of instruction. Operator participation is encouraged. To 1973, seven courses have been held with an average attendance of 90.

Annual Water and Wastewater Works Short Course

In 1928, the University of Iowa initiated a Water Works short course. Since that time, over 35 have been held. In 1967, a wastewater works short course was held jointly with the Water Works short course. As a result, a two-day combined course is held annually and directed primarily to the level of plant superintendent, engineer, chief operator, and regulatory agency personnel. An average of over 100 attend this course. Since 1964, the State Hygienic Laboratory staff has held a one-day laboratory symposium the Monday preceding the Water Works short course. This symposium covers a different timely topic each year and has averaged over 30 in attendance.

Annual Water Resources Design Conference

In 1960, Iowa State University initiated a series of annual water resources design conferences. The conferences are two-day periods of training in some area of water resources. Proceedings and books have resulted from some of the conferences. All conferences are directed primarily to engineers involved in water resource management. Topics covered have included flood plain management, aerobic biological wastewater treatment, upgrading treatment plant design and operation (1974), and so forth. Registration for the conference has ranged between 50 and 150.

Other Training

For many years, the Iowa State Department of Health sponsored a one-day meeting of operators in each of the seven health department regions. These meetings were designed to provide about four hours of training and a visit to the host city treatment facility. Separate meetings were held for operators of water and wastewater treatment plants. Such meetings died out in the 1960's when the Health Department was forced to use its personnel "more effectively."

In the past few years, the two Iowa Associations have revived these meetings in the six Department of Environmental Quality regions. The meetings are designed to open an avenue of communication with the one-man plant operators.

In recent years, Kirkwood Community College has established various entry-level wastewater operator training courses with federal assistance. During the last two years, the Department of Environmental Quality has provided on-the-job training for operators from approximately sixty wastewater plants, also under a federal grant. Kirkwood Community College has, during the past year, begun on-the-job laboratory training for wastewater plant operators through the use of a mobile laboratory and grant funds provided by the United States Environmental Protection Agency. Kirkwood Community College has also done a limited amount of water works entry-level training on federal grants.

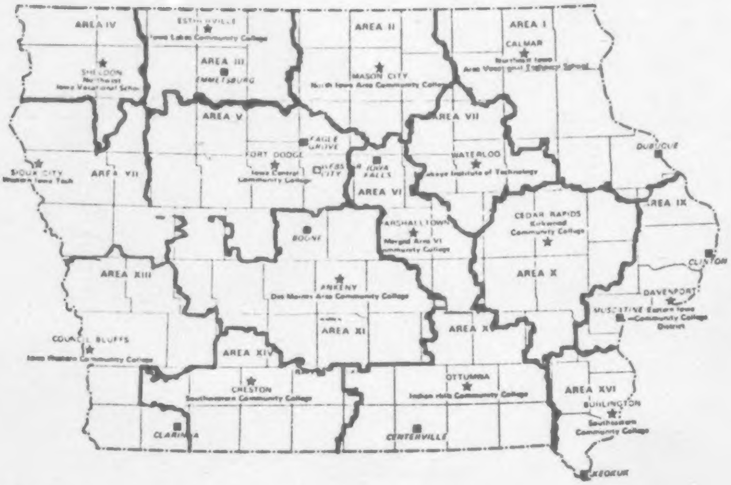
All the federally funded training programs appear to be of limited duration due to the lack of any commitment for continued funding by the United States Environmental Protection Agency. A number of community colleges have indicated a serious interest in developing similar training courses, but have made little progress primarily due to the lack of qualified administrators and educators in these fields and also due to funding problems. Iowa area-community college locations are shown in Figure 3.

The Operator Certification Board, Department of Environmental Quality, state universities, Kirkwood Community College, other community colleges, and the Iowa Water Works and Water Pollution Control Associations are interested in and working on development of additional education programs for operators.

Funding Operator Training

No single agency in Iowa has assumed responsibility for providing funding support of training of water and pollution control plant operators. From 1954 to about 1964, no instructors in the basic training course received compensation or reduced teaching loads for participation as course instructors. Since about 1965, course instructors have received some compensation (from $15 per hour of class time at Iowa State University to $25 per hour of class time at the University of Iowa) for the basic and laboratory training courses. Since 1973, no Iowa State personnel have received compensation for participating in operator training courses. No compensation is given for participation in other training activities since they are presumed to be part of normal university extension activities.

MERGED AREA SCHOOLS


AREA IV
SHELDON
Northwest Iowa Vocational School
ESTHERVILLE
Iowa Lakes Community College
AREA III
EMMETSBURG
AREA II
MASON CITY
North Iowa Area Community College
AREA I
CALMAR
Northeast Iowa Area Vocational Technical School
AREA V
FORT DODGE
Iowa Central Community College
EAGLE GROVE
WEBSTER CITY
IOWA FALLS
AREA VI
AREA VII
WATERLOO
Hawkeye Institute of Technology
DUBUQUE
SIOUX CITY
Western Iowa Tech
AREA XII
AREA IX
CEDAR RAPIDS
Kirkwood Community College
MARSHALLTOWN
Merged Area VI Community College
BOONE
ANKENY
Des Moines Area Community College
AREA XI
AREA X
AREA XIII
COUNCIL BLUFFS
Iowa Western Community College
AREA XIV
CRESTON
Southwestern Community College
CLARINDA
AREA XV
OTTUMWA
Indian Hills Community College
CENTERVILLE
CLINTON
DAVENPORT
MUSCATINE Eastern Iowa Community College District
AREA XVI
BURLINGTON
Southeastern Community College
KEOKUK

★ Administrative Center and Campus

■ Other Campus (area schools with more than one major campus)

FIGURE 3

Location of Iowa Area-Community Colleges

For the period up to 1972, some support of operator training was obtained through the Iowa Department of Vocational Education (U.S. Funds) and the Iowa Technical Services. This support has now been terminated due to a termination of federal support. As a result, all operator training involving the two universities must be supported by course fees. This will dictate the more efficient use of personnel in planning and conducting operator training programs.

APPROACH TO PLANNING

Background

The Iowa Department of Environmental Quality is, by Iowa law, responsible for administering Iowa legislation pertaining to water supply, water pollution control, air pollution, solid waste disposal, and so forth. By intent and practice, the Iowa DEQ is an *enforcement* agency and does not conduct or support financially research or educational programs directed at operation or training of operators for water and wastewater treatment facilities. The Iowa DEQ has, however, provided both moral support and encouragement for development of first a voluntary and later a mandatory operator certification program and a training program to support it.

Educational programs for training of engineers and scientists at the baccalaureate and graduate levels are conducted at both the University of Iowa and Iowa State University.

In 1965, the Iowa legislature passed laws providing for the establishment of a system of community colleges and area vocational-technical schools throughout the state. A total of 15 area community colleges was established. Figure 3 shows the location and area boundaries of each of the merged area schools.* Kirkwood Community College, the Area X school, was formally established on July 1, 1966. With support from the U.S. Environmental Protection Agency, but *without* coordination with existing state operator training programs, the Kirkwood Community College established several environmental education programs:

--In *1968*, a one-year *Environmental Health Assistant* program.

--In *1970*, Kirkwood, in cooperation with and with assistance from the Iowa DEQ, began training employed Iowa wastewater treatment plant operators to upgrade their skills, using traveling instructors.

---

*There currently is no Area VIII School.

- --In 1971, Kirkwood, funded by the U.S.E.P.A., offered its first 22-week training program on campus for wastewater treatment plant operators.
- --In 1972, Kirkwood again with support from federal and state agencies, initiated a 22-week program to train water treatment plant operators.
- --In 1973, Kirkwood adopted a new Associate of Arts two-year degree option to the original Environmental Health Assistant Curriculum.
- --In 1972 and 1973, Kirkwood began overseas training programs in wastewater operations, solid waste management and pest control technical fields.

Program Development Personnel

The development of a coordinated, unified plan for training of water and pollution control plant operators in Iowa has involved the participation and cooperation of the following groups:

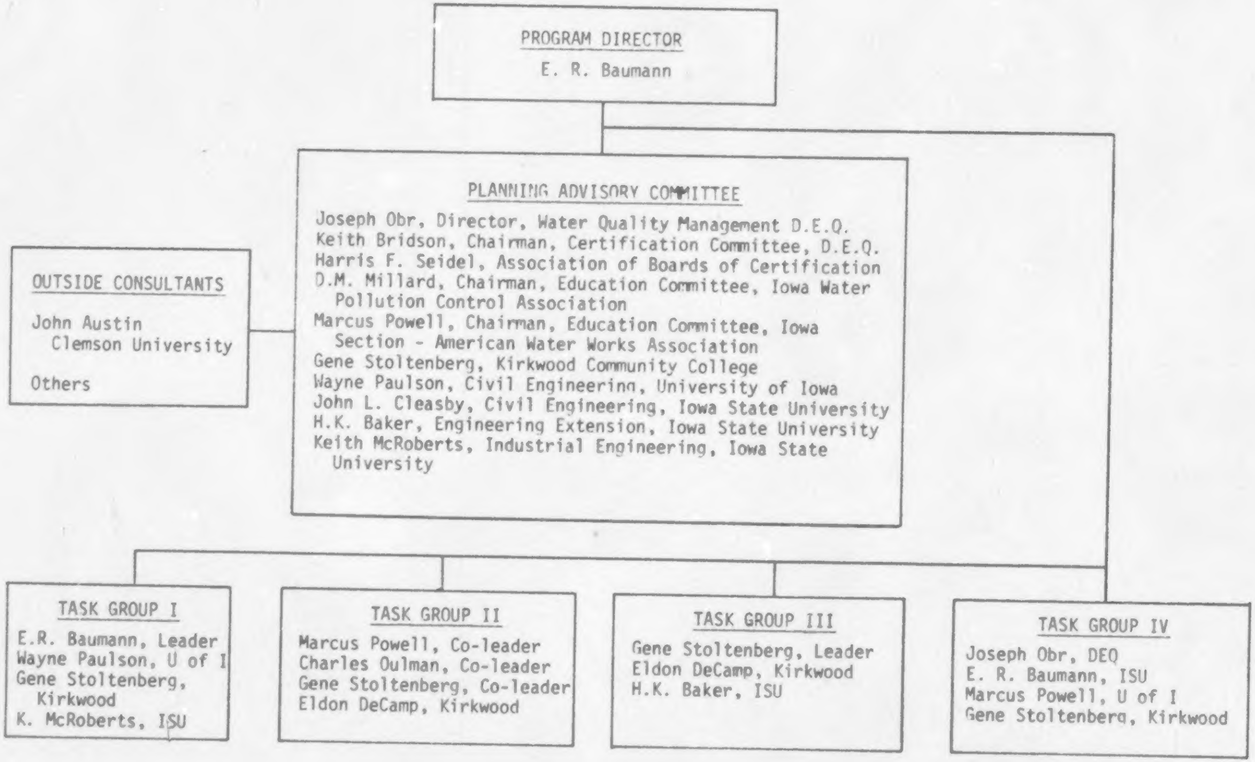
- --The Iowa Department of Environmental Quality
- --The Iowa Section, American Water Works Association
- --Iowa State University Department of Civil Engineering and Engineering Extension Service
- --University of Iowa, Department of Civil Engineering and State Hygienic Labs
- --Association of Boards of Certification
- --Kirkwood Community College

All agreed to cooperate in the development of a coordinated, effective operator educational program in Iowa. To accomplish the elements of the program, the organization shown in Figure 4 is being used.

DEVELOPMENT OF INTEGRATED OPERATOR EDUCATION AND TRAINING PROGRAM

Effective career development of operators of water and water pollution control plants requires availability of both education and training programs. In general, education programs reflect the basic role of two- and four-year colleges and universities, and vocational-technical schools can provide the required training. Education and training needs must be identified separately and provide for both new entry personnel and upgrading existing personnel.

Preliminary meetings of personnel proposed for the advisory group in this study indicate that a unified, coordinated statewide plan for education and training of operators would involve the following programs, each of which has been assigned to a task group for implementation:


PROGRAM DIRECTOR
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PLANNING ADVISORY COMMITTEE
Joseph Obr, Director, Water Quality Management D.E.Q.
Keith Bridson, Chairman, Certification Committee, D.E.Q.
Harris F. Seidel, Association of Boards of Certification
D.M. Millard, Chairman, Education Committee, Iowa Water Pollution Control Association
Marcus Powell, Chairman, Education Committee, Iowa Section - American Water Works Association
Gene Stoltenberg, Kirkwood Community College
Wayne Paulson, Civil Engineering, University of Iowa
John L. Cleasby, Civil Engineering, Iowa State University
H.K. Baker, Engineering Extension, Iowa State University
Keith McRoberts, Industrial Engineering, Iowa State University
OUTSIDE CONSULTANTS
John Austin
Clemson University
Others
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Wayne Paulson, U of I
Gene Stoltenberg, Kirkwood
K. McRoberts, ISU
TASK GROUP II
Marcus Powell, Co-leader
Charles Oulman, Co-leader
Gene Stoltenberg, Co-leader
Eldon DeCamp, Kirkwood
TASK GROUP III
Gene Stoltenberg, Leader
Eldon DeCamp, Kirkwood
H.K. Baker, ISU
TASK GROUP IV
Joseph Obr, DEQ
E. R. Baumann, ISU
Marcus Powell, U of I
Gene Stoltenberg, Kirkwood

FIGURE 4

Operator Training Program Planning Organization

Task Group I

Education of plant superintendents or managers.
- M.S.-level degrees in sanitary engineering for large-sized plants.
- B.S.-level degrees in engineering operations for large and medium-sized plants.
- A.A.-level degrees in Environmental Control technology for small-sized plants.

Task Group II

Continuing education of plant operators.
- Basic training courses in treatment processes.
- Laboratory training courses concerning analytical techniques.
- Short courses involving management, design, etc.

Task Group III

Continuing training of plant operators in vocational-technical schools.
- Basic maintenance-repair programs.
- Basic skills programs (arithmetic, communications skills, chemistry, etc.)

Task Group IV

Development of a single coordinating office for operator training in Iowa.

Task groups were formed for the development of a training program in each of these areas. A basic assumption is being made that any successful program for operator training must be locally self-supporting if it is going to succeed. Program development includes:

--Development of curriculum,
--Development of course syllabus,
--Selection of qualified educational/training centers to initiate or develop program, and
--Development of program authorization and local funding.

Each group started from a record of accomplishment and has a defined goal.

Task Group I

Education programs should be conducted in post high school educational centers and in universities. The state of Iowa in 1965 established 15 area schools consisting of combined two-year colleges and vocational-technical schools to support the three major state-supported universities. The fifteen area community colleges are publicly supported and operate under the regulation of the Iowa State Board of Public Instruction. The University of Northern Iowa, the University of Iowa, and Iowa State University are the three publicly supported state universities governed by the State Board of Regents.

The University of Iowa and Iowa State University both operate engineering colleges and award both Master of Science and Doctor of Philosophy degrees in environmental and/or sanitary engineering. Many such graduates of both institutions have entered the field of water and water pollution control plant operation. For example, Dr. H. F. Seidel, currently is Director of Water and Pollution Control for the City of Ames. The Task Group will develop a program of course electives at both universities for M.S.-level students which will be available to prepare them better for entering the field of plant operation/management.

The industrial engineering curriculum at Iowa State University affords essential training to those who have strong aptitude and interest in engineering and a potential capacity for management. A special curriculum in Engineering Operations (administered by the Industrial Engineering Department) consists of a basic core of required courses in the sciences, engineering, and management to which are added 95 credits of elective courses in special categories of engineering, sociohumanistics, management, and supporting subjects. With this framework, we have an ideal framework for building specific occupational objectives related to pollution control plant management. The Task Group has developed the core of courses (most already existing) that would permit production of trained operator/manager personnel.

Both university engineering college programs permit qualified students to complete effectively two years of the engineering program in the area community college. Thus, cooperation of the universities and community colleges should be able to facilitate an additional level of entry-point personnel into plant operation.

The task group is working with the area community colleges to develop a two-year Associate of Applied Science degree program in Environmental Control Technology.

The curriculum in Environmental Control Technology would provide for completion of 100 quarter credits of work to cover approximately the program coverage recommended by the Federal Water Pollution Control Administration in their Technical Education Program Series No. 11 entitled "Water and Wastewater Technology, a Suggested Two-Year Post High School Curriculum."

The curriculum would be scheduled and advertised so that a student could complete the first year of the program in any of the state's community colleges and then transfer to one community college which would conduct the second year of the program. At present, it appears that the Kirkwood Community College by location, available facilities, and experience would be ideal for conducting the second year of the program. This Associate of Applied Science degree in Environmental Control Technology would be awarded by the college offering the second year of the program.

In order to make the proposed program viable, the number of personnel that would have to be trained at each level might approximate the following:

M.S. or Ph.D. level	
Iowa State University	0-2/year
University of Iowa	0-2/year
B.S.-Engineering Operations (Environmental Control)	
Iowa State University	8-10/year
B.S.-Engineering (Environmental Control)	
University of Iowa	1-2/year
Associate of Applied Science (Environmental Control Technology)	
Kirkwood Community College	20/year
TOTAL	29-32

Ideally, some of the two-year graduates might become candidates for the Engineering Operations degree.

A question that needs to be explored is "Does Iowa need and can it support such a program?" The answer on first evaluation appears to be "yes!" The Iowa Board of Certification of Water and Wastewater Treatment Plant Operators reports that there is an approximate 10 percent turnover of operators in responsible charge of both water and wastewater plants per year. Thus, there is a need for about 50 waterworks operators and 75 pollution control plant operators to meet this turnover each year. Many existing operators will upgrade to occupy such positions, but it is not unreasonable that at least 28-30 new entry-level, well-educated personnel will be required yearly to service the 560 water pollution control plants and 762 public water supply plants in Iowa, particularly in view of the tightening regulations under which they have to operate.

Task Group II

This task group would be responsible for the planning for and implementation of continuing education programs of education and training for operators. In 19[illegible] the Iowa House of Representatives passed House Concurrent Resolution 18 (65th General Assembly, first session) requiring all state licensing boards to submit information prior to Assembly development of "continuing education" requirements for continuation of licensing. In a January 10, 1974, response to that request, Keith Bridson, Secretary of the Iowa Board of Operator Certification included Table 3. Table 3 indicates the Board's recommended contact hours and frequency of continuing education requirements for maintaining a given level of operator certification. Table 1 lists the Board of Certification summary of existing continuing education opportunities available specifically in areas of water and wastewater treatment.

Table 1, Part A, lists established training courses which are supported by adequate fees and are strong continuing programs. They can, however, be updated, presented in a more effective format, and expanded. The water and wastewater basic training courses are now the heart of the operator training program in Iowa, but need expansion and improvement.

This task group is charged with developing an integrated series of twenty-four hour (eight days of three-hour sessions) training courses including:

Water Pollution Control Plant Operation

1. Basic training course.
2. Basic hydraulics for plant operators (units of expression, flow in pipes, flow in sewers, flow-measuring devices, pumps, pumping stations, etc.).
3. Aerobic biological processes (fundamentals of lagoons, trickling filters, activated sludge processes, nitrification, plant control and operation, etc.).
4. Anaerobic biological processes (fundamentals of anaerobic lagoons, digestion, denitrification, etc.).
5. Physical-chemical processes (fundamentals of grit removal, sedimentation, thickening, filtration, etc.).

Water Treatment Plant Operation

1. Basic training course.
2. Basic hydraulics for plant operators (same course as for pollution control plant operators).
3. Source and distribution of water (wells, distribution systems, elevated tanks, ground storage, etc.).
4. Physical-chemical treatment processes (aeration, disinfection, stabilization, softening, coagulation-flocculation, sedimentation, filtration).

The task group will:

--determine what courses are required and an order of priority for their development,

--prepare a course syllabus,

--form a small group to prepare the lectures and visual aids,

--prepare a sample videotape cassette of the course material.

An important function of this task group is to plan and implement training courses in such a way that they can be presented on an economical basis. Thus, the basic training courses can be and are given at least six times each per year to an average of 30 persons each. At a $50 charge per operator to a city per course, such courses can be self-sustaining. Additional courses, however, may only be given once or twice per year to a more limited group and special study may be required to make them "fly." Thus, availability of the basic lecture material on tape could reduce the time required for university-level expertise in each course. A logical three-hour course program might provide for:

A two-part cassette lecture part 1---------------40 minutes
discussion-----------20 minutes
part 2---------------40 minutes
discussion-----------20 minutes
A problem-oriented class exercise----------------45 minutes
break----------------15 minutes
TOTAL 3 hours

The Task Group II assignment is critical to the entire training program since it is the major base for operator training. Time must be made available by reducing the 108 half-days of effort expended on an essentially voluntary basis by university personnel to develop and present the "new" training courses required.

Task Group III

Task Groups I and II are concerned with education and training directly related to water and pollution control plant operation. Task Group III would concern itself with the development of "adult education" courses required in general skill areas. The required skills would be identified, a general course syllabus would be developed, and a mechanism for giving the courses arranged.

General skills required by plant operators include many skills that are also required by many employees of other business and industry. Such vocational-trade training is the assigned function of the states area-community college. Thus, this is the source for development of such skill area courses as the following:

--arithmetic and/or higher mathematics,
--communication skills,
--basic electricity,
--pump and motor maintenance and repair,
--basic accounting and records,
--fundamentals of plant instrumentation, etc.

The task group would prepare an operator-education brochure covering all courses available in the state and explain how a group could be organized to request that a course be given at a fixed time and place. This group, of course, would have to coordinate activities with each of the state's area community schools to make the program available.

Task Group IV

If education-training of operators of water and wastewater treatment plants is to continue on a fully integrated-coordinated basis, it is necessary that a single coordinating office be established. This function might best be handled by the certification officer of the Department of Environmental Quality, although it also might be located in the Engineering Extension at Iowa State University or elsewhere. This question will need consideration by this Task Group. At present, an extension specialist is furnished for this purpose by Iowa State University. This is the most important--and yet the most difficult--funding problem. The training coordination office needs a minimum specialist/secretary/travel/supplies budget of at least $30,000 per year. It currently operates partially on state funds and partially on an EPA grant.

SELF SUFFICIENCY?

If the proposed operator training program is going to be economically self-supporting, it will have to be relevant. That's a problem for the staff that's employed to conduct the program. In order to be able to get the students into even a relevant program, we also need some promise of reasonable award. I would be remiss in discussing operator training if I did not discuss the level of reward dollars which will be involved.

Dr. Harris F. Seidel recently made an analysis of the beginning salary of the "shift operator" of the 25 largest cities in Iowa. The "average" Iowa shift operator, a position which a one-year community college graduate could be expected to fill--has an average 1973 salary of $8,300 per year. In 1974-75, graduates at the B.S. level in engineering at Iowa State had an average starting salary of $13,400 per year. This means then, that if we expect to attract students of such caliber in operation training, in 1975 dollars we will need to establish minimum salary levels of:

--one-year diploma graduates----------------------------$ 9,000- 9,500
--Associate of Arts graduates---------------------------$11,000-11,500
--Bachelor of Science engineering graduates-------------$13,500-14,000

Obviously, we cannot achieve such rewards for operating personnel unless the State Departments of Environmental Quality and the State Certification Committees will do their jobs in making sure that states and cities hire people who have the proper qualifications for the job. We cannot develop training self-sufficiency if cities and states can hire "off the streets" and approve only on-the-job training at sub-standard wages. The training program can be successful--but it will need support of all those with interest in improvement of our water quality.

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EDUCATION OF MARINE TECHNICIANS: A TWO-YEAR PROGRAM

Richard E. Sylwester

Shoreline Community College is a two-year college located north of Seattle, Washington. It offers a number of educational opportunities in the applied arts, applied sciences, occupational-vocational technology and continuing education. The enrollment in all programs this year is about 7000 students.

For the past six years, the Math-Science Division at Shoreline Community College has been developing a Marine Science program that offers a A.A.A.S. degree in either Marine Biology Technology or Oceanography Technology.

The goals of this program are to provide qualified marine technicians to the scientific and engineering community. We use the title marine technician to describe an individual who is involved in activities centered around the marine environment. We believe that to effectively carry out these activities requires a strong background in the traditional sciences as well as vocational-technical skills. This philosophy was followed in developing the curriculum for our program.

The final objectives of this philosophy are to provide a technician who has the background and professional attitude to:

1. Plan and organize field sampling programs or field studies.
2. Properly collect, log and store field samples.
3. Carry out preliminary laboratory data analysis and prepare post cruise or field reports.
4. Provide technical support for maintenance of field and laboratory equipment.

We feel that an individual who can accomplish these tasks with minimum or no supervision has a solid foundation in the marine sciences, and that his or her potential for professional development is unlimited.

To achieve these objectives, a curriculum has been designed that attempts to develop the students' knowledge - gradually and evenly (Table 1 and 2). Special

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Richard E. Sylwester is an Associate Professor at Shoreline Community College (near Seattle), where he teaches oceanography, electronic instrumentation and field techniques in oceanography, and coordinates on-the-job training for students and job placement of graduates.

TABLE 1

Oceanography Technology

An Environmental Science Technology stressing field experiences in the physical aspects of oceanographic data handling, and sampling. Technicians work on board ship and in shore-based laboratories. All aspects of water environments, both salt and fresh, are measured and surveyed. The technician is prepared to be versatile in the field, building, troubleshooting and repairing field equipment. He is provided with the skills necessary to understand the scientist and to carry out the work of the scientist in the field.

*Prerequisites that must be taken before entry into the sophomore year:
English 101 or a score of 68+ on pre-college test
Math 40 or 101 or score of 65+ on pre-college test
Chem 101 or 1 year of high school chemistry

FRESHMAN YEAR		SOPHOMORE YEAR	
Fall		Fall	
Oceanography 101..........	5	Electronics 142..........	4
Engineering Tech 150......	5	Chem Tech 190............	6
Beginning Scuba 140.......	2	Photography 100..........	3
Geology 101...............	5	English 270..............	3
		Electives................	
	17		16
Winter		Winter	
Electronics 140...........	4	Chem Tech 191............	6
Applied Math 191..........	4	Ocean Tech 196...........	4
Industrial Tech 102.......	4	Computer Math 200........	2
Advanced Scuba 240........	3	Electives................	
Electives.................			
	15		12
Spring		Spring	
Electronics 141...........	4	Chem Tech 192............	6
Applied Math 192..........	4	Ocean Tech 197...........	4
Engineering Tech 155......	5	Marine Biology 103.......	5
Industrial Tech 160.......	4	Electives................	
	17		15
On-the-Job Training			
Ocean Tech 170-171........	12		

Electives:

Environmental Science 200, 201 (Environmental Monitoring Law and Techniques)
Industrial Technology 103, 115, 116 (Machine Shop, Welding, Plastics)
Physical Education 241 (Advanced Scuba II)
Ocean Tech 174 (Underwater Photography)

TABLE 2

Marine Biology Technology

An Environmental Science Technology stressing lab and field experience in the biological aspects of marine science. Technicians work on ships, in laboratories and in the field. Biological principles coupled with the physical and chemical aspects of the marine sciences are learned. The technician is prepared to assist the researcher, supervisor or scientist by preparing his gear for field work, collecting his data and maintaining his equipment.

*Prerequisites that must be taken before entry into the sophomore year:
English 101 or a score of 68+ on pre-college test
Math 40 or 101 or score of 60+ on pre-college test
Chem 101 or 1 year of high school chemistry

FRESHMAN YEAR		SOPHOMORE YEAR	
Fall		Fall	
Biology 101	5	Chem Tech 190	6
Oceanography 101	5	Biology Techniques 195	5
Photography 100	3	Electronics 142	4
Electives		English 270	3
	13		18
Winter		Winter	
Invertebrate Zoology	5	Chem Tech 191	6
Electronics 140	4	Ocean Tech 196	4
Applied Math 191	4	Electives	
Computer Math 200	2		
Electives			
	15		10
Spring		Spring	
Marine Biology 103	5	Chem Tech 192	6
Electronics 141	4	Ocean Tech 197	4
Applied Math 192	4	Microbiology 201	5
Electives		Electives	
	13		15
On the Job Training			
Ocean Tech 170-171	12		

Electives:

Environmental Science 200, 201 (Environmental Monitoring Law and Techniques)
Industrial Technology 102, 103, 115, 116, 160 (Machine Shops, Plastics, etc.)
Physical Education 140, 240, 241 (Beginning and Advanced Diving)
Zoology 112 (Vertebrate Zoology)

thought has been given to means by which course material can incorporate information from one or several previous courses. For instance, math classes relate new equations to their use in chemistry or electronics. This helps to integrate the individual subject and certainly stimulates greater interest in new material --in addition to reinforcing concepts previously learned.

In addition to lecture materials, students are exposed to extensive laboratory work and vocational technical classes. Here again, as in the lecture courses, we endeavor to provide laboratory exercises that introduce new material as well as providing insight into ideas and concepts previously introduced in lectures or seminars. Although the vocational-technical courses (welding, machine shop, electronics, etc.) are more difficult to include in this "feedback" type of system, we use every opportunity to directly integrate their capabilities into the academic aspect of the program. In the past, this has been accomplished through special projects done by students in various technical classes. Besides being a valuable learning experience for the student, these projects have enabled us to obtain physical models for classroom illustrations, laboratory instrumentation equipment and oceanographic sampling gear.

Removed from our campus physically, but of great importance to our program, is the field training. We have found that a large amount of time spent by the students in preparing for field work, actually working in the field and carrying out post-cruise operations (e.g., sample analysis and storage), is not only justifiable but a must. We believe that intensifying this aspect of our curriculum both solidifies the students' previous academic and technical course work and provides the necessary "fine tuning" that results in a highly competent field technician.

In our program, we use two approaches in order to provide students with field experience. These are: 1) two quarters of field oceanography called Oceanography Technology 196 and 197, and 2) on-the-job training (OJT) with state and federal agencies or private industry.

For the field courses Oceanography Technology 196 and 197, the students are divided into groups consisting of three to four students. Each group is assigned a region in Central Puget Sound, usually containing several estuaries, in which they will work during the two quarters. During this study, the possibilities for learning scientific methods, gaining both field experience and self-confidence, are limitless. Of course, notwithstanding the rains, it is a good deal of fun. In summary, the students have the following criteria to meet in order to receive credit for these two courses:

1. Carry out extensive literature research in order to collect papers, data, charts, maps, etc., that are pertinent to their areas.

2. Plan a sampling program for their study areas that includes gathering:
    - water samples
    - sediment samples
    - bathymetric data
    - S.T.D. measurements
    - biological net hauls
    - vertical and horizontal plankton hauls
3. Schedule and coordinate their cruise plans with the other groups and the faculty field advisors.
4. Prepare sampling equipment and collect the field data.
5. On-shore beach transects and off-shore beach transects using scuba equipment.
6. Store data properly prior to analysis and complete analysis of all samples - as soon as possible.
7. Compile and analyze data for presentation in final report form.

This approach gives the student a broad spectrum of experience in all facets of an environmental or baseline study. The actual cruise experience gained during the data gathering activities on our 22-foot boat involves only about 10 days for each student. To provide additional field experience, we have developed a strong OJT program.

The OJT program provides a number of important subsidary benefits, besides additional field experience, that can only be obtained through outside associations. For example, future employers have an opportunity to evaluate individuals that they may wish to employ upon graduation. Of course, the converse is true, a student has the opportunity to evaluate a possible future employer or at least to become familiar with the different organizations and types of jobs available; i.e., do I want to work with a small company doing a number of different jobs or with a company that specializes in a particular earth science, etc. Another aspect of OJT is that it tends to make academic course work much more meaningful to the student and can greatly improve his or her attitude towards careful laboratory and field work.

There are a number of ways that students gain OJT experience. Some students are only exposed to one phase, while others may have a chance to try several. This auxiliary program now includes such opportunities as:

1. Doing field sampling with private companies.
2. Participating in cruises with governmental agencies (NOAA, USGS, Dept. of Fisheries).
3. Assisting graduate students in data collection and analysis.
4. Participating in cruises with the University of Washington.
5. Design and construction of field or laboratory equipment for academic institutes.
6. Assist in baseline studies of Puget Sound being carried out by S.C.C.

The length of time each student is involved with any particular OJT activity can vary from days to months. Also, monetary gains by the student for a project vary and in many instances no salary is given. Fortunately, even though uncompensated, students realize the importance of the experience and contacts; and, thus far, we have been able to provide individuals for all outside requests.

This past year, we have expended our OJT program so that we ourselves are hiring the students. This has come about as a result of a paper we presented at the Northwest Estuary Conference at Oregon State University. The data was from work done by the students in the graduating oceanography technology class from this past year. The paper stimulated interest in several agencies with regard to our program, and these agencies have now contracted with us to provide them with ecological data from certain areas of Puget Sound. These contracts have provided jobs for a number of our students, added money to our budget for new equipment and created increased enthusiasm within the program.

Although we feel that our program is developing quite well and has definite strong points, we are aware of weaknesses or at least know of areas that we anticipate changing or modifying. Some ideas being considered are: providing a class that integrates photography, illustration or graphics and technical report writing; adding an additional course in calibration, maintenance and repair of scientific instrumentation; increasing the relationship of concepts provided in the science and math courses; provide additional time for students to become involved in projects at school or at least combine projects with training in the technical classes; and reorganizing the order in which some of the courses are taken so that students are better prepared for a particular course. Of course, the constraints on a two-year program limit addition of new material to a finite number of courses without giving up other ones, and decisions regarding what to give up in order to make additions are extremely difficult. I would like to conclude by providing you with some information on placement of our students since that seems to be a logical way to evaluate a particular program's success.

From 1967 to 1974, the number of students graduating has increased from 6 to 24 (Table 3). Of those graduating, we have averaged a job placement of 85% in marine science related fields. The remaining 15% is accounted for by students who are either employed in other fields, transferred to four-year colleges or whom we have no trace of. The latter group accounts for less then 1%. So essentially, we have been able to place all of our graduating classes, with the majority of these jobs being marine oriented.

TABLE 3

STUDENT EMPLOYMENT RECORD

YEAR	NUMBER OF GRADS.	NUMBER EMPLOYED IN MARINE TECHNICAL JOBS	SERVICE	NUMBER TRANSFERRING TO A 4-YR. COLLEGE	OTHER OCCUPATION	NO TRACE
67-68	6	6		(2 later)		
68-69	12	10	1	1		
69-70	13	11		1		1
70-71	8	7		1		
71-72	12	10				1
72-73	20	13		1	2	4

STATUS OF GRADUATES 1973-1974

Number of graduates.......................... 22
Number employed.............................. 18
Number transferring for further education..... 2
Whereabouts unknown.......................... 0

1974 Graduates	Where Employed and Position Held	Is Work Related To Training
Jim Askew		
George Burqhardt	NMFS, Marine Bio Tech - 3 mo., presently in Navy Diving School in San Diego	Yes
Jim Bragg	Transferring for further education - Huxley	Yes
Tim Cleveland	NOAA - Survey Technician	Yes
Theresa Cole	EPA - Lab Technician	Yes
Glen Dodge	METRO - Water quality and field tech	Yes
Gerry Douthitt	Water quality consulting firm in Hawaii	Yes
George White	Wash. Earthquake Adv. Council, Research tech and administrative assistant	Yes
Harry Haslam	METRO/Kramer, Chin, Mayo - Water Quality tech.	Yes
Larry Iverson	APL - Marine science Tech/transferring to Huxley	Yes
Tim Johnson	ARCO/Hanford, Richland - Science Tech	Yes
Steve Kellog	NOAA - Survey tech	Yes
Frank Klobertanz		
Charles Langstaff	Skipper fishing boat, Alaska	Yes
Pat McGettigan	John G. Shedd Aquarium, Chicago - Marine Bio Tech	Yes
Tom McIntosh	Dames & Moore, Seattle, Earth Sciences Tech	Yes
Bob McKee	Equipment repair and sales, Seattle Skin Div. Sup.	Yes
Jim Mount	ARCO/Hanford, Richland - Science Tech	Yes
Bill Shearer	NOAA, 3 mo. Survey tech, now at Flow Research in Renton as Marine Science Tech	Yes
Claude Sterling	Converse Davis Co. - Earth Sciences and lab tech	Yes
Jack Thurman	ARCO/Hanford, Richland - Science Tech	Yes
Gary Wilton	Dept. of the Environment, B.C. - Marine Bio Tech	Yes

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We would like to express our gratitude to the Sea Grant Program of the Department of Commerce, and, particularly, to Dr. Allyn Duxbury at the University of Washington's Office of Sea Grant. Their financial commitment to Shoreline Community College has made possible the creation of our program. Special thanks also go to the faculty and administration of Shoreline Community College whose support and professional expertise have made our job enjoyable. And, finally, we are indebted to the scientists and crew members of the University of Washington research vessels who have provided our students with a wealth of knowledge and irreplaceable experiences.

Session 8

VOCATIONAL TRAINING OF WATER AND WASTEWATER UTILITIES PERSONNEL IN WASHINGTON

Donald E. Proctor

Most people today have some degree of familiarity with Dr. Christiaan Barnard. He became world famous for a heart transplant operation on December 3, 1967, that prolonged the life of one Louis Washkansky for 18 days. Admittedly, the justifiable recognition was for the technique rather than just for 18 days of life.

How many of you people know the very noteworthy accomplishments of Larry Wallin--or of Tim Bushey? Both have been contributing to the prolongation of many lives. Not for 18 days, but for years! Neither has been guest of honor at a ticker tape parade or had his picture on the cover of a national magazine. Larry operates the Sewer System and the Wastewater Treatment Plant down in Ilwaco, Washington. He can't possibly know whether there is a typhoid carrier in town or not, but he presumes there might be one on any given day. He works to the limit of his ability to see that potential disease organisms are not washed up on the beach or clinging to the tip of a monofilament line that some angler bites off with his teeth.

Tim Bushey is engaged in taking water from the Skagit River and converting it into safe drinking water for the city of Anacortes. When people go to the tap at the kitchen sink for a drink, they don't pause to wonder whether or not Tim has done his work properly. In truth, most of them have never heard of Tim. Many don't even know the source of their drinking water.

A popular advertisement in magazines and on billboards has the message, "You've come a long way, baby!" The same could be said about the utilities responsible for obtaining, treating and distributing our community water supplies and for the collection, treatment and disposal of the wastewater from those communities. The message needs to be lengthened, however, to read, "You've come a long way, baby--but baby, you still have a long way to go!"

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At about the beginning of this century, a new-born child had an average life expectancy of about 45 years. Since then we have developed many new ways to shorten life spans. We now have high speed automobiles and more leisure time in which to chase death down the freeway. We now make it possible for thousands of skiers to slam into trees and each other on any winter weekend. We have created easy access to bridges and tall buildings for anyone contemplating suicide. We have an efficient, though illegal, distribution system for drugs that convince people that they can fly from one building to another. In spite of so many new ways to die, at least 20 years have been added to the life expectancy of an infant during the last 70 years. More than just a small portion of this extension of life expectancy can be credited to improved water supplies and wastewater treatment. We no longer accept numerous annual outbreaks of typhoid as "normal--to be expected". Cholera no longer causes 8600 deaths in one year among 640,000 people, as it once did in Hamburg, Pennsylvania. A visitor to a world's fair, such as EXPO '74, need not take a gutful of amoebic dysentery home as a souvenir as did at least 1400 individuals returning from Chicago in 1933. (Ninety-eight known deaths resulted, also.)

The part that the water and wastewater industries have played in this extension of life expectancy has not been easy or cheap. Vast sums of money and materials have been invested in facilities. Sophisticated treatment processes and elaborate control systems have been financed, designed and constructed to provide safe water to cities, towns, resorts and even some rural areas. Water distribution systems consisting of pipes, valves, meters, fire hydrants and other appurtenances now extend out into areas that were cornfields, deserts or forests only a decade ago. Both storm drains and sanitary sewers collect great flows of wastewater from areas that were formerly characterized by swamps and pit privies. Most of that sanitary sewage and some of that storm water is now subjected to some degree of purification or treatment before entering our rivers, lakes, marine waters or underground aquifers. Liquid industrial wastes are now treated to remove or reduce many contaminants that were unknown to man only a few years ago.

One point of information about our past accomplishments and future needed accomplishments must be stressed. The willingness of people to provide the capital for these facilities, the capability of our engineers to design these facilities, and the competence of our construction industries to build these facilities would not, by themselves, have resulted in any significant benefit to either mankind or nature. The benefits accrue to society only when the facility systems are staffed by operations, maintenance and management personnel.

The work of Larry Wallin, Tim Bushey and hundreds of other utility employees of the water and wastewater utilities involves both decisions and subsequent actions based upon those decisions. An improper decision can be worse than non-productive--it can be the cause of a major public health hazard. A bad decision can also result in a significant inconvenience to many people, a significant deterioration of environmental quality, an unnecessary level of operating expense, or even the catastrophic loss of the publicly-owned facilities.

The day-to-day decisions involve elements of mathematics, chemistry, physics, hydraulics, biology, economics, sociology, psychology, personnel management, public relations, safety and common sense. It is not enough that the personnel be constantly alert to any of many possible malfunctions of units, processes or systems. They must also be able to recognize such malfunctions, plan a proper set of corrective steps and then execute those plans.

It is simply absurd to assume that just anyone is qualified to operate, maintain or manage the highly specialized and sophisticated water supply and wastewater control systems of today or the more sophisticated systems of tomorrow. Written, cookbook-style instructions may almost adequately guide a water treatment plant operator through a shift of normal operation. Such programmed-robot capabilities cannot provide for the recognition of all abnormal conditions, though. The untrained individual can hardly be expected to plan and execute the proper corrective steps when a malfunction occurs.

Assuming that we do recognize the critical need for our utility staffs to be highly skilled in regard to their vocational duties, we come now to the major issue: How can society be assured that operation, maintenance and management functions are assigned to properly qualified people?

Several different efforts or programs in the state of Washington are directed toward the objective of improved personnel skills and qualifications. While each of these programs is capable of somewhat independent operation and direction toward individual goals, they are quite compatible. Each program reinforces the others.

Two personnel certification programs are now operational and a third is under development. A Wastewater Treatment Plant Operators Board of Certification, acting for the Washington Department of Ecology, is empowered to receive and review applications, review the education and experience of applicants, conduct written examinations and direct the issuance of certificates attesting to the competency of wastewater treatment plant operators. The Board also grades the size and complexity of treatment plants. The individual in day-to-day responsible charge of each wastewater treatment plant is required by law to hold a valid operator's certificate of a rated grade equal to or higher than the treatment plant grade. All other operating personnel are encouraged to seek their highest attainable grade of certification on a voluntary basis.

A somewhat similar program provides for the certification of both water works and water works personnel. This Water Works Certification program is currently not a mandate of law but is expected to become so during the next legislative session.

A third voluntary certification program is now being developed to assess and recognize the skills and competencies of people engaged in the operation and maintenance of sanitary and storm water collection facilities.

The above three certification programs are specifically operated within and for the state of Washington. The rules, regulations and policies are quite similar to those recommended nationally by the Association of Boards of Certification, though, so reciprocity with certification programs in other states may be developed.

It is not enough to simply specify the skills and capabilities that personnel in various positions must possess. Such certification does not assure the availability of a sufficient number of adequately skilled people. Two ongoing vocational training efforts are directed toward the development of an adequate number of adequately skilled personnel.

One of these vocational training programs is primarily intended to provide opportunities for currently employed water and/or wastewater utility personnel to upgrade their present skills and capabilities. Such training opportunities may be in the form of evening continuing education courses within commuting distance of their present homes and jobs. Special short courses, seminars or correspondence courses are also offered to assist in this skill-upgrade program. The majority of such currently employed people simply could not afford to leave their work to participate in an extended full-time vocational program. Neither could their employing utility operate successfully during the prolonged absence of the employee. Most of the skill-upgrade training opportunities are in the form of three-hour sessions, one night per week, for an eleven to thirteen week period. Such courses may be offered by one of the 23 community colleges, by a state vocational-technical school, by a private training institute, or even by a specific utility. Such courses provide specific vocational-technical knowledge and understanding to supplement the very valuable experience gained through their current and past employment in the vocation.

The second training effort is a full or part time preparatory training program at Green River Community College. This vocational program specifically prepares new people to enter the vocation. They have an opportunity to gain a firm understanding of the mathematical, chemical. physical and biological principles that apply to their future vocation and further to thoroughly understand the treatment and maintenance processes and procedures. Actual experience is limited to summer employment, but their training will contribute to very rapid development of operational skills and expertise when they enter the vocation as full time employees of utilities.

Both training programs--skill upgrade and preparatory--are being developed with certain goals and criteria in mind:

1. The areas of needed skill development involve more than just "how to do it" techniques. Wastewater treatment plant operators do need to know how to determine proper chlorinator feed rate settings and how to set that rate on a specific chlorinator. They should also understand the necessity for latent heat of evaporation to convert liquid chlorine in a cylinder to chlorine gas at the chlorinator. In short, skill development involves knowing both "how to" and "why". The "how to" skills may be adequate for routine operation when all circumstances are normal. The "why" knowledge is vitally important to the determination of proper corrective action when circumstances are not normal.
2. The successful operation of the overall system of processes and facilities involves more than the application of technical knowledge. A successful safety program involves both knowledge about the impact strength of hard hats and about the behavior characteristics of a person who may have just attended his mother's funeral. Training opportunities must provide for some understanding of psychology as well as water quality analysis techniques. Understanding the organization of municipal and state governmental structures may sometimes be as important as knowing how to inspect and test a back-flow prevention device. Verbal and written communication skills contribute to the success of public relations and to the successful negotiation of a renewed waste discharge permit. Maintaining chemical and spare parts inventory records is almost as necessary as being able to compute chemical dosages or to install a new shaft seal on a centrifugal pump. In short, the skill upgrade and preparatory programs must include a balance of vocational water and wastewater technology courses and other general development courses.
3. The time available for training or skill development is limited. Whether an individual is involved in the part time evening course skill upgrade training effort or the full time preparatory training program, we should not expect him or her to expend much time or study effort on material that is not vocationally relevant. At the same time, we cannot demand or expect that every institution will offer a specialized course

> in "vocational psychology for the water meter readers". The educational sector must strive to respond to the relevant vocational training needs of the water and wastewater personnel, but the utilities personnel must also adjust to the economic and personnel limitations of the educational institutions. Not every chemistry instructor will have had experience in the latest methods for determining volatile acids concentrations in digested sludge--nor will every operator be anxious to learn about the chemistry of zinc smelting. Both must be willing to adjust to the needs and interests of the other.

Let me summarize a bit. First, I realize that I have presented very little in the way of specific details about the curriculum of two-year colleges in the area of environmental education. My specific interests are in the area of vocational training opportunities related to the water supply and wastewater utilities. Society must be assured that competent people are available to operate, maintain and manage these utilities if we are to protect our health, preserve our environment and maintain economic reason.

The numerical adequacy and competency of utility personnel is dependent upon the adequacy and applicability of both vocational and related training opportunities. These opportunities must be within reach of those individuals now employed within the utilities and other individuals preparing for such employment. The training must be delivered in a system that recognizes the time limitations of people who have a vocational mission in life.

I would like to stress one additional point that relates quite directly to the adequacy of the supply of skilled personnel for the water and wastewater utilities. It is only indirectly related to the need for training opportunities. We do not advance the quality of our water supplies or improve the quality of our environment simply by training well-qualified personnel or by building environmental facilities. The skilled people must be hired and retained before training costs return any benefits to society. If a skilled operator, maintainer or manager is not adequately rewarded, he will notice an economic incentive to become a used car salesman or a dragline operator for a construction firm. We should not expect his dedication to public service to be his only motive for protecting our health and environment. We must appreciate his contribution toward our desires and express some of that appreciation in the numbers on his pay check.

DISCUSSION

Question: I have a question for Dr. Proctor. Especially in your first type of courses, the up-grading courses, I'm assuming that probably the utilities are paying their people to take these evening courses.

Proctor: I wish that were true.

Question: It's not? It would seem ideal to include in their up-grade efforts people who have been working in wastewater five or ten years, to instill in these people a sense of worth of the environmental aspects. Many of these people received their training and education when "environment" wasn't even a vocabulary word. Are attempts being made in this? Do you have a way of coordinating the programs in Spokane compared to programs in Seattle and Wenatchee and Yakima, wherever they are?

Proctor: There is some amount of coordination in this effort. But I would back up and say probably there is no group of people in this United States that needs it less than they do. They may not have a complete understanding of all of the various ramifications of any particular environmental issue, but they certainly have an appreciation of it. I wouldn't sell the people short on how concerned they are about the environment. I find very few water plant operators or sewage plant operators who aren't willing to devote an extra seven hours on Saturday afternoon and evening just on plant beautification alone because they appreciate that. The problem is that they won't get one red cent, and they'd probably have to buy the flowers out of their own pocket.

Question: So you feel that you're working already with an environmentally conscious group?

Proctor: Very environmentally conscious group.

Question: Both of you have an emphasis on job placement. You're training people for a particular vocation and I noticed especially with Professor Sylwester,

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Rosemary Richardson, of Bellevue Community College, was the moderator for Session 8.

you spend a lot of time in placing these people. Are you given released time through your school or do you have to do this on your own time? Maybe now you have good sources, but in the past you had to spend quite a bit of time establishing these sources.

Sylwester: There's no released time yet. We're trying to work toward that. I feel better about my job when I can get students placed or on-the-job training aspects incorporated in the program. They certainly feel a lot better when they are involved in this.

The hardest thing I have found is that you have to train industry about what technicians are. In the past, particularly in the science field (not so much with welders or dental technicians, somehow they are more accepted), industry hasn't known what they are or how to use them. So we have to go out and convince people that these people are highly qualified to do a particular job. It's really tough. I wrote a nice letter to the U.S. Geological Survey in California about hiring some of the students or trying them on summer jobs, and one comes back that says, "You have a very fine program but we hire people who have four-year degrees in geology." On the last trip to the Arctic they did take six students, and they were totally amazed, it convinced them. It's the same with private industry. It's a real Madison Avenue approach. You've got to really convince these people. You have to get your foot in the door. But you have to give them good stuff. Once you lose your credibility, I can tell you, you are all through.

Proctor: I completely agree with the credibility and the selling too. I said there was no past history in water and wastewater training in Washington, but there was. In 1970 there were funded programs under the Manpower Development Training Act, two programs. Each had approximately 20 students in it, limited strictly to wastewater and strictly to treatment plant operation. Each program graduated approximately 20 students in the second week of June of 1970. They met with a list of municipalities, sewer districts, water districts that had never before hired a trained individual. If there is any time of year that is bad as far as finding something left in a city's budget, it's the month of June. They probably will not have an approved budget that they can work with until the last of August. So with no history of someone trained for that job ever having been hired, we dumped 40 of them on the job market in June.

There were some additional strikes against the program. I think it was doomed to failure. One of the conditions under the Manpower Development Training Act was that 60 percent of the people enrolled in the program had to be in the hard core unemployable ranks. They had to be of a minority race, physically disabled, mentally disabled, beyond the age 47, under age 18 and I can't remember what the other category was. There probably was someone in this group of 40 people who was mentally deficient. Now, we're not going to embarrass anybody by saying it's Joe there who's mentally deficient. Look at the city that might be hiring one of them. We might hire the man who's mentally deficient, and if he falls in the firing ground, we're negligent. No thanks, we won't touch one of them. And out of that 40, six got jobs.

The biggest single obstacle to overcome in getting this program started is, "You've done it once before and it failed." And we did do it once before and it failed. I wasn't involved in doing it, but I would have probably done it the same way because they did it the way they had to do it. That was the only way they could get the thing funded. Neither institution knew the other was doing it until they were on a collision course in the second week of June when they finished. I don't know how many other things you could have thought up to assure that it wasn't going to work, but it sure didn't. I'd like to cite better history but I can't.

Question: Three small money questions for Dick Sylwester. Do you take out-of-state students in your program and if so, what do they pay?

Sylwester: Out-of-state tuition, I think, is about $150 a quarter. Yes, we do.

Question: Number two: Does your institution finance all of your field work and transportation? Do the students have to pay?

Sylwester: The institution pays for all of it, and we're getting additional funding now because we are going out and doing private contracts.

Question: Number three: The people that you place in positions, are they being paid roughly the equivalent of other people who come out with two-year diplomas from community colleges?

Sylwester: I tend to think that they're getting more. I think they are getting an average salary starting at about $750. I have a couple of students who are making over $1,000 a month. They're really good. One fellow started at $500 a month, a 32-year-old guy, and he was a meatcutter making pretty good money, and it was pretty hard. So we had a little bet. I knew he was good, and I just told him to stick it out. So I bet him a half gallon of Scotch, and he came over two months later and he had gotten a $2,000 raise. And I got a half gallon of Scotch.

Question: I have a question for both speakers. Speaking of the job market, what's the market for one with ambition who graduates from one of your programs?

Sylwester: I've never tried to look at the market to try to guess what it's going to be. Students will ask us about chances of employment in two and a half years and I tell them, "I can't honestly tell you." All I can say is, look at records for these past five years and look at the increasing employment, and we also have an increasing number of students, and say we can extrapolate from there. It's worked out well. I think that what's happening is even in the job market itself, there may not be new positions added. It's that more people are realizing the uniqueness of good technicians, and they are finding out how to use them.

Proctor: There are roughly 850 certified wastewater treatment plant operators in the state of Washington alone now. There are around 930 certified water works personnel in the state, and I know that that's somewhere between a third and a half of the total. I would like to think that 20 years from now, most of the positions will have been filled by people trained when they went to work. That has no application to today's situation. There are many people operating wastewater treatment plants on a sixth grade education. I would not agree that those people are incapable of learning. They have never had the opportunity, and it is time to do something about it, and we're trying.

Question: Do you see any increased demand for this type of person? In other words, maybe other community colleges could train people as science technicians, but direct their efforts away from the oceanographic approach or your marine approach. Do you see any demand for people in other areas?

Sylwester: Yes. One example would be civil engineering technology. I think there's really a need there. But I don't think the effort has been made to find out what positions there are, and get people in them. In other earth sciences it is the same way, geology or geophysics or whatever.

Question: Your initial setup was funded by Sea Grant. What advice would you give to a community college that wanted to set up one of these programs, for a general science technician or as you say a civil engineering technician, when the community college doesn t have a spare budget?

Sylwester: I was fortunate because I worked in the industry for a long time and know how to get money or know people who are out there. You have to get people who are going to spend a lot of time, over eight hours a day, to go out and find them, with the motivation and professional attitude to make it work. There's no other way. The money's hard to get.

Richardson: I think we see this in all program developments, which might be a good lead-in to the time we have remaining to talk about how the two-year schools can develop programs in general studies in environmental education, as well as the technical training programs that you two have just discussed. Some of us are interested in this, perhaps in promoting the environmental ethic. I think we're all here because we are seeking some kind of advice, assistance on how these programs can be set up, if that's the direction to go. I know there are some people here who are working on this and can give us some advice.

Comment: On general education of the future public of the United States or of the world? Not that they're going to apply it vocationally, it's just that we need a better informed citizenry--this kind of thing?

Richardson: Yes, how our two-year colleges can work on these kinds of programs. Your advice has been specific about the technical programs, but wouldn't it apply as well to general studies? In other words, the kinds of successes you've had, your input and even your failures, can we not use this advice as well? Perhaps we're not training a specific technician for a specific job. How can our schools work just to create the environmental ethic? This is part of the reason for this symposium.

Answer: Absolutely.

Question: If our educators were set up to teach English from an environmental ethic, to teach history from the environmental view....geography would be a fantastic example. How can we go back to our respective institutions from this symposium with some advice on how we can improve the situation at our schools?

Answer: This is one suggestion. Take off your shoe and bang it on the table until you get it. Someone else is yelling louder than you are. When you yell louder than he does, you'll get something. So, in the first place, I think you have to be a boat rocker. You may even sink the boat a couple of times, but find a new one and keep rocking. I don't think that we should wait for somebody to give it to us. You have to go out and get it.

Comment: It's difficult to teach something that you don't know anything about. So people who have been in the education process for 20 or 25 years, something like that, may not relate their subject matter to the environment per se. They see the environmental issues but they don't bridge the gap. So maybe some refresher seminars or some guest speakers or something like that, perhaps people from this symposium could give talks on various subjects, maybe they could visit the campus and give a two-hour seminar to try to bridge some of these gaps.

Sylwester: I would suggest as a source any one of these students about ready to graduate. Pay his transportation and I'll bet he'll do it.

Comment: One of the things the Institute for Environmental Studies is proposing for winter quarter is a three or four day workshop for superintendents and school board members of the public school system, not at the college level at all, but at the elementary and high school level. The feeling was that it's going to be very difficult to set up some kind of curriculum if the superintendent of the school board doesn't buy it. And he might be willing to buy it if he is shown reasons for it, and we're trying to cover the theory of growth and quality of life, as well as environment.

Comment: Well, if you can sell him--when he beats on the table with his shoe, people listen. The school superintendent beats better than the rest of us.

Comment: There's also a close relationship to the community, when you start reaching the local schools.

Answer: Following along these lines, each of us could go back to our respective schools and set up an evening seminar series, a weekend seminar series designed specifically for our faculty on our campus, perhaps as reference points on how they might bring environmental awareness into their courses.

Comment: Most of us are educated in a specific area, and I think that many of us have been afraid--in my case, to step into the humanities--to pretend to suggest to them that you might change your course. Who am I from science to say to you in English, you ought to teach this? I think we've perhaps been afraid to get a big heavy boot and stomp it on the table.

Question: Why do you insist on it being change? This is an interjection into what they are already teaching. People think, if I change, it means I won't have a class to teach. Well, that's a lot of baloney. I can take a course in quality of literature and I can interject it in there, expand it. Maybe I have five areas to cover in a semester. Stick a sixth one in there. You're not changing anything, you're just adding to it.

Comment: Don't you think that there's a lot of this going on anyway? Because we have people in economics, we have people in geology, we have people in art, we have people in English, physics, chemistry, biology, all pushing that environmental angle, and we're beginning to work together and coordinate....

Comment: I also remember a phone call we had not very long ago, from the economists at the University of Washington who refused to work with the civil engineers or people in atmospheric sciences, and they're just not going to have any more meetings with them. And that was it. I looked back to the previous meetings to see what kinds of interpersonal relationships had developed, but at the university level people are so locked in sometimes to their disciplines, and they really do refuse, even at a party, a social event....

Answer: Maybe that's why we can get a community college to enter in, there's more intercommunication between the groups at that level.

Comment: There's an awful lot of awareness that doesn't seem to take. I can recall in some 11 years at Washington State University we had several student-generated meetings on things related to the environment. It didn't matter if it was students or faculty or who it was, after the meeting they trailed their candy bar wrappers down the walk like everyone else. They took the same shortcut across the lawn that everyone else did. I think we have a level of awareness, but it's not a constant level of awareness, that the things we do every minute of the day are part of our environment.

For example, if the public didn't want the aluminum throw-away pop can, you couldn't sell them. I don't think we need legislation, I think we need a boycott at the cash register; but until you get people sold on it, you can't get the boycott. I would imagine that the total advertising budget of one of the major pop companies is directed at gaining another 2 percent of the market. And if they faced losing their whole share of the market, if people wouldn't buy it unless it was in a returnable bottle, possibly they would turn around overnight. I'm not pretending to solve the solid waste problem, but you can only sell in the marketplace what the people are ready to buy.

Comment: If we are already environmentally aware, as somebody else said, why aren't we doing this? Why are we so tolerant of legislative changes that say, "Let's not clean up car pollution for two more years." Or, "Let's rescind our air quality bill of 1970, because now we have an overriding concern." Why are we so prone to accept it when someone says, "Environment can cost....", which we've been told is really less than one percent...."and that's why this plant is being shut down." And we as the collective public accept that. I think that on one level, we are environmentally aware. On another level, we are still not environmentally concerned.

Question: What can we as educators do to promote being concerned, to care?

Answer: You have to give them a living example. We can speak of the starvation in the other parts of the world, we can speak of the ruination and the defoliation of landscape over in Asia. And it's not going to involve us at all. You need to show them pictures of the Dakotas. If it's not in their own backyard, their stomachs are still full.

Question: Are we going to spend the afternoon wailing about why we as individuals haven't solved all the problems? We've had some pretty good presentations here about how you train technicians and can, in a small area, improve the environment. In Illinois in the coming spring an authorization will be given to all community colleges to establish an environmental resource fund which can be anything, it can be nothing or it can be a whole lot, depending on the individuals, the school and so forth. It may be started with released time of one faculty member, but that can be the catalyst within the school to improve the exposure of interdisciplinary environmental awareness. It could be all sorts of potential programs about working with the community, working with special training in relation to the geographical location of the school.

Question: Is this being state funded?

Answer: It will be funded by the individual school and once again, they will be authorized to do it. How well it is funded depends on what the individual school will do. It's up to you whether you can promote it with your board, your administration, whether that particular environmental subject is established, what you can generate among yourselves in terms of services you render--to local public organizations or to industry, and so forth. It's not going to be just a grant handed out, it won't be utopia tomorrow. It will be just something to operate on within existing resources.

Proctor: I ought to make a clarifying remark, I think, and one of warning. That is, do not spread yourself too thin. Don't attempt to do 200 percent of what you can get done. Don't let your enthusiasm for solving problems convince everybody you're going to have them solved tomorrow. Because if you tell them you will, they'll expect that you will; and this is where I was very naive. All I have to do is call 23 community colleges and I'll have courses all over the state. And six weeks later you're still trying to find out who to talk to at such and such a place. By that time they expected 20 of those courses to be going.

Question: Getting back to the programs, what about transfers? Do your students transfer to a four-year program or do they stay pretty much with the program where they are? How do they feel once they start to become successful?

Answer: I'm getting more and more students who are transferring. I'm getting a surprising number of students who get a tech degree knowing they are going on, which really surprises me. A lot of credits are not accepted and that makes it tough to come in there, either after you've gone through the program or at the beginning, and say, "I'm going to get a technical degree"--say, 90 or 100 hours, knowing that only 15 of them are going to transfer. But a lot of them feel it's worthwhile to have a background where they can do something when they're going to school or during the summer; or it simply gives them a better understanding of what's going on in the sciences; in this case, it's worthwhile to do it.

Now, what helps a lot, and it's kind of an ironic thing, one of the benefits of the Vietnam War is that we have a lot of GI's with the GI Bill who can afford to do this kind of thing. In other words, spend a little bit longer in school than they normally would, and they have some way to support themselves.

Some schools are doing all they can to accept as many credits as they can, because they're in trouble. Western Washington State College is in trouble regarding the number of students. And so they're making it easier to accept some other credits, for instance if a student had a couple of quarters in electronics and maybe physics, they might accept that as the required two quarters of physics they'd take there normally.

Question: I would like to ask, have you done any work coordinating with the four-year colleges in relation to this? What are the results?

Answer: Very good. They're trying to think about some of these courses, for instance a chem technology series, which is a three quarter series. Most students there are required to take quantitative and qualitative analysis, and the college is willing to accept this for quantitative analysis, for instance.

Question: What does this do to the job market, to people who are looking for the two-year graduates, if they transfer?

Answer: There aren't many transferring--in my case probably two or three out of 25, and I'll probably have 30 this year. And the job market's there. I guess the problem is that some schools feel that we're taking positions that would normally go to a four year graduate. That sometimes creates a problem, particularly when our students are working with that university on a job, and they feel, "This guy is going to finish with a two-year degree and take a position that one of our four-year Bachelor of Science people might get." And I don't know how to answer that, except by just turning out the best people that we can and if somebody wants to use them in place of your people....

Comment: I would answer that with, "Isn't that tough."

Answer: Yes, but when you're relying on their facilities for training, you have to be a little more subtle.

Question: What would industry do if they needed these trained people and they weren't available? Would they set up their own training program? Hire people and then train them?

Answer: Most of them haven't recognized the need for those people yet. But when they recognize it, they'll have to do something to get them. You need something like seven to ten technicians to do supporting work for a good scientist, and we've been turning them out the other way around--about seven scientists for every one good technician. We're in a transition period, and it's going to be very rugged.

Proctor: Going back to the question of transferring, in the preparatory program in water and wastewater technology at Green River Community College, both water and wastewater courses add up to a total of 45 credits, of which only two carry a number high enough even to be considered for transfer credit. I'm devoting my efforts to putting people in water and wastewater treatment plants, not to encouraging them to use that as a steppingstone to somewhere else. If they want to step, like anyone else they can start at a four-year college and go. I have no objection to that. But my purpose, my mission is to see that the water and wastewater utilities are adequately staffed to fill the needs of society. I'm extremely selfish. I am not looking particularly at the needs of the technicians, I'm looking at the needs of society for those people.

ENVIRONMENTAL INTERDISCIPLINARY RESEARCH--HOW CAN IT BE DONE?

John M. Neuhold

The substance of this presentation is based on personal experience in a variety of management positions for a variety of organizations from governmental to academia. It is characterized as preaching what is practiced.

A definition of "interdisciplinary research" is appropriate to start off the presentation. Comparing this term with "multidisciplinary research" will be helpful in this regard. Multidisciplinary research can be said to require different disciplines working independently of each other until a given level of achievement is reached, at which time synthesis may occur across the individual efforts. Many fields of endeavor produce multidisciplinary products in the form of knowledge. This quite often results from the normal functioning of the system in the absence of a purposefully conceived interdisciplinary approach. Sometimes, quite fortuitously, a synthesizing genius comes along and applies the necessary insight to fashion a new concept, theory or law from relatively disjointed individual efforts, perhaps producing the basis for another field of inquiry.

Interdisciplinary research is defined, in contrast, as the same process, but greatly accelerated. Basically, we speed up the process by providing tools, including an environment which promotes rapid interdisciplinary communication during all phases of the effort. A goal is first identified after which effective lines of communication are established. Given that an interdisciplinary effort would be expeditious in addressing a problem, the different disciplines and individuals to be involved in solving the problem must be identified. A procedure then is implemented which creates the kind of environment which facilitates rapid, almost instantaneous, communication across disciplines.

An interdisciplinary effort is generally algorithmic, whereas a multidisiplinary effort is essentially iterative in nature. In the interdisciplinary effort, progress assessment goes on constantly, while in the multidisciplinary effort it does not occur until substantial effort has been placed into the project. The interdisciplinary effort can often foresee blind alleys or new directions and

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make immediate adjustments, while the multidisciplinary effort must await a synthesis of the results before these decisions can be made. This often means starting all over again. Theoretically the interdisciplinary effort, by virtue of constant communication, is sensitive to all input and can modify its function to efficiently meet a given goal.

Ideologically, an organization is a system which facilitates people working together to accomplish a given mission or task. There are several primary characteristics inherent to every organization. These can be identified as (1) a communication network which is not entirely independent of either; (2) an authority or decision-making structure; (3) a reward structure; and (4) a mission or a task, i.e., a set of goals and objectives the organization tries to achieve. Above all, an organization is made up of people, and this "people component" is of paramount importance. A common characteristic of thinking administrators is a concern for the quality of his people, the well being of his people, and the environment in which his people work. If people are willing to work together for a common set of goals, the work will get done. Care must be taken to optimize resource allocation such that excessive organizational or structural input does not detract from or prevent organizational function. Maximum emphasis on organization as such will defeat the functional purpose of the system which is to produce a product.

The size of the organization is also important in this regard. Consider a large interdisciplinary program, on the order of 100 people, then the entropy or the cost of maintaining a communication network becomes high relative to the total project in terms of dollars. This results in reduced output. The system produces less as entropy increases.

The converse is also true. That is, if you get a group that is so small, three or four people, then the responsibility of communication falls on each of the individuals. In other words, each of the individuals has to carry a part of the administrative load, detracting from direct project activity. So a smaller system also has high entropy relative to the total amount of dollars going into that particular system.

Intuitively, one would expect an optimum between the very large and the very small interdisciplinary efforts. In field ecology efforts, this tends toward 10 or 12 people, and at our current level of buying power, something on the order of $400,000 to $500,000 per year. An organization of this size can effect maximum communication with least cost in terms of maintaining an administrative structure to accomplish communication. This may vary from project to project, depending on the kinds of questions asked. Generally, however, it is easy to maintain a communication network among 10 or 12 people as opposed to 100 people. And the cost, relative to the total dollar income, is relatively small.

The International Biological Program Biomes, which were of the order of 100 people and $1.5 to $2 million dollars each, provide us with experience in large (for ecology) organizations. The problems in maintaining a good communications system, at least initially, were almost overburdening. A lot of time went into implementing and maintaining a communications effort. Consequently the output, especially during the first two or three years of each project, was low. It was not until individuals within each group had become familiar with each other, to the extent that they did not overtly have to make the effort at communication, that the productivity began to flow. It took about three years to learn how to communicate effectively.

The organization must accomodate this communication need and can do so efficiently by incorporating communication processes into one of its goal-oriented objectives. Once the attention of the group is focused upon the goal, the scope and mode of communication is established. For example, ecologically oriented programs with the objective of synthesizing a model (an ecosystem simulation) can use the model as an ideal vehicle for focusing the attention of the group. If the modeling effort is made central to the overall project, it becomes an automatic tool to force communication. Communication continues to be important for the duration of the project, and as people become familiar with each other over time, communication increases and the organization functions as a cohesive unit.

The process of familiarization is perhaps worthwhile looking at in more detail. An interdisciplinary group assembled to address a complex question goes through a process not unlike that experienced by those familiar with group dynamics in short term sessions. A question or theme is identified. A convener calls people from salient disciplines together to address the question. The behavior of such a group in session is initially characteristically territorial (everyone wants everyone else in the group to learn of and accept his competence). The wise convener allows this to happen. The process not only allows for ego-reinforcement but it identifies perspective and jargon differences--differences which have to be resolved before effective communication can occur.

The second phase involves the identification of the intellectual leader who may or may not be the convener. The individual who expresses himself best and who demonstrates synthesizing capability is usually identified as such and is accepted by the group. Once the intellectual leader is accepted, entree is made into a third phase in which the individuals of the group meld their identities, territorial aspects are foregone, and the group gets on with the interdisciplinary work.

The process is involved, sometimes subtle, and it takes time. The larger the group, the more divergent its individuals, the more time and organizational structure it takes.

Another important aspect of successful interdisciplinary work is the identification, creation, and maintenance of a suitable working environment. Physical and temporal proximity which foster casual and incidental contact is essential. The leader of an interdisciplinary program tries to accomodate the effort by grouping his people together, providing services which maximize time on direct project activities, and rewarding individuals for their part in the effort. Taken one step further, the institutional environment in which interdisciplinary programs are encouraged to develop and flourish embodies many of the same characteristics: access to individuals across department lines, strong and empathetic services and rewards for interdisciplinary successes.

It is interesting to note that universities with good records of success in interdisciplinary activity are often land grant institutions, problem solution oriented in their research programs, with mixes of cosmopolitan faculty in conservative rural settings. In this kind of environment people have to lean on each other socially as well as professionally. They learn each other very well. Each other's works, personalities, and needs are more fully understood. In short, much of the preliminary, territorial process incumbent in group dynamics is already accomplished and entering interdisciplinary activities becomes easier.

The traditional view of universities, however, is not that amenable to the development of interdisciplinary activities. If they are, it is in the "soft money" institute mode. Little if any hard money support is made available. Traditional structure of a university is under departmentalized disciplinary lines. Rewards are gained by individuals for accomplishments within the discipline and services to the department. Departments seek to gain reputation as centers of excellence in their disciplines. They are rewarded by their peer community with recognition. They accrue to themselves excellent graduate student resources. They compete successfully in competition for grants and contracts. For these accomplishments the university administration rewards departments with preferred treatment in its resource allocation. Departments in turn reward their members with tenure, promotion, and salary increases. The system is strongly institutionalized in academia with several centuries of precedence.

Interdisciplinary programs detract from this traditional view. Sharing a productive faculty member with another discipline in another department dilutes production within the department. The credit for grants and contracts produced by interdisciplinary efforts cannot be fully accounted for by the department. A student in an interdisciplinary program is not as clearly a student of the botany department as he is a student of the interdisciplinary program. Thus a faculty member, particularly a young, untenured one, finds himself in a hazardous position if he opts to go the interdisciplinary route in terms of traditional departmental rewards. A department simply cannot bask as fully in the glory of holistic, interdisciplinary efforts as it can in the traditional, reductionist, disciplinary ones.

Society, however, places continuing demands on academia--demands which reflect its own increasing complexity, demands and questions which cannot be met by any single discipline. Knowledge produced by disciplinary efforts too is increasing to a level where synthesis becomes not only possible but imperative under the pressure which society is generating. Thus a dilemma is posed--institutional disciplinary traditionalism opposed to institutional interdisciplinary nontraditionalism.

Disciplines are departmentalized because they have the basic element of integrity. This element of truth must be tested ever more rigorously for the discipline to exist. It can be argued that interdisciplinary efforts require the input of the disciplines with their inherent integrity and thus are not less truthful. The potential, however, exists that a greater truth can be discovered. Thus, both become important. The rigor and standards set by disciplines must be applied to interdisciplinary efforts, but not in an inflexible way. One does not kill the child before it is born.

Traditional attitudes are changing but perhaps not fast enough. Multiple authorship is more acceptable now than it was 20 years ago. Sharing pieces of grants and contracts is more acceptable now as well. Yet the rate at which interdisciplinary efforts are successfully undertaken appears painstakingly slow.

Those institutions which have been successful in their interdisciplinary efforts have been so because they have been sensitive to traditional departmentalism while at the same time nurturing the fledgling. Some of the salient features of these programs include (1) a hard money funded institute with which to buy the time of faculty resident in departments; (2) assignment of graduate students to departments in which the major professor holds tenure; (3) agreement among departments for standards of performance; (4) an operating fund which departments can tap for their associated faculty; (5) participation in control of the interdisciplinary effort, and (6) a credit allocation system recognized by the central administration for research grants and contracts earned by the interdisciplinary effort.

Programs nurtured under this type of system pose no threat to departmental structure. In fact, previously unrecognized benefits often accrue in the form of additional flexibility in terms of both operating budgets and diversity of faculty. When departments build into their statement of goals the willingness to step over departmental boundaries and be helpful, the institution is well on its way to the type of an environment in which interdisciplinary work can be accomplished successfully. Under those circumstances, the grassroots faculty member with the freedom and the rewards to interact will, and will do so with success.

COSTS OF INTERDISCIPLINARY RESEARCH -- PROCUREMENT VIEW

Panel: Brian Mar, Jane McCarthy, John Neuhold

McCarthy: I'm Jane McCarthy, and the reason I'm at this table is that for four years I was a consultant to the Ford Foundation. I put together or monitored six grants for the Ford Foundation and their Resources and Environment Program in the general area of interdisciplinary research on waste management. These were grants to local and regional government, and all of them had, or all but one had, a strong component of university involvement. Part of the idea was to see if the university could be of some assistance in the environmental area to the normal workings of government. We came a cropper in several, and there are some interesting lessons. I suppose that these observations bring me to the symposium.

Mar: I'm Brian Mar, and I'm with the Environmental Institute. I'm up here, I guess, because I was part of the planning committee, and we couldn't convince the people that would like to buy these types of projects to come. The other reason is to show you how important this project is, that the funding agencies have at least agreed to spend the type of money John was talking about to find out how you do interdisciplinary research, just to study research. We are trying to determine how to do that. There are people at this conference from eight different projects, all with studies like this, asking, "How do you study research, particularly interdisciplinary research?" I might be able to add a little insight to those types of problems.

I think I'd like to ask both John and Jane about this, and John in particular, take off your Utah hat and put on your old National Science Foundation hat maybe, and comment with me. I've noticed in working with people who do these kinds of projects that the Ford Foundation actually tried to help the groups form, where at NSF the groups had to sort of fly by themselves. We might just compare these

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Frank Corrado, of the Environmental Protection Agency, Region V, was the moderator for Session 9.

Brian Mar is Professor in the Department of Civil Engineering and in the Institute for Environmental Studies, University of Washington.

two styles to find out whether from the Ford experience you need this outside catalyst to get an interdisciplinary group, or whether John from the NSF thinks you might conclude that the universities know enough to get off the ground by themselves.

McCarthy: We had to form the groups because governments do not traditionally go to private foundations for money. We wanted to stay out of the university arena because we thought part of the experiment was to see what the local government would do. We actually didn't stay out in two of them. We gave to the universities. One was the University of Hawaii, and the other was the University of British Columbia, both of them modeling simulation grants and both of them much more along the lines of the kinds of things that you're talking about.

Mar: I've noticed that Hawaii has gone through a lot of evolution.

McCarthy: All of them went through a tremendous evolution. I think one of the lessons for a funder is perspective, because what you thought was going to happen never does. So you have to be very comfortable and flexible as a funding agency if you want to play in this ballpark, and be sure not to pull the rug out because the rules have been changed. You can be very sure that the rules are going to change. Did you have that problem?

Neuhold: You bet. Every one of our interdisciplinary programs changes its goals and its objectives as it moves along. But I think that's characteristic of an interdisciplinary program. That has to be an outcome or else it's not functioning right.

McCarthy: People got hurt. One person got fired. You have to realize that you're affecting people's lives in a very direct way.

Neuhold: I would say in response to Brian's question that the only time I would put human resources to work on a developmental proposal is when I have a feeling that there's a relatively good probability of getting the money. If I feel that we have a 60% chance of success, then I'll put the dollars and peoples' time in on it. That assumes, of course, that the money is available, that a funding institution is willing to listen to you in this particular area, and that you've done some groundwork. A lot of effort has to be expended, and that I take on as my own responsibility. I don't put my faculty to work on proposals unless I really have to call in some expertise to develop these proposals on the Congressional scene or on the foundation scene. This means that, from conception of an idea until the time that something actually does happen may take anywhere from five to ten years. When I function in that particular mode I don't do it by myself, obviously; I do it with the others, my peers and my national community and sometimes international community to see that it's accomplished. That kind of effort is useful in itself, in that if a pot is finally created that you can draw on, you can start plowing money into your program to address that particular pot.

Question: You said that you have $2.7 million, was that the figure you gave? And one-third of that came from the university?

Neuhold: One-tenth came from the university.

Question: Where did the rest come from? Are these government agencies, are they businesses? Who is coming to you for work?

Neuhold: Who are we going to for work? National Science Foundation, EPA, Fish and Wildlife Service, Forest Service, Bureau of Land Management, Corps of Engineers, Ford Foundation, Rockefeller Foundation, Battelle Memorial Institute. There's another principle I follow, an ecological principle, and that is to keep diversity.

Mar: Jane, what do you think about this? There's been some bad reaction to interdisciplinary research. Are the funding agencies gun-shy now when universities come in with so-called interdisciplinary proposals?

McCarthy: I can't speak for funding agencies in general, but Ford's still active. Foundations are very political and there's been a change in the leadership in the resources and environment section of the Ford Foundation. I would say that it's still interdisciplinary. But as I said earlier today, it's very important to go in and tell people what you're doing. What is going to be funded in the next two years is probably known now. So if you want to get in the pipeline, establish any kind of credibility, start making your contacts and get in, not to present a proposal but to say, "Gee, thought you might be interested in knowing."

Question: I know all three of you have a vast array of experience on some different ways of interdisciplinary research. Have the results been worth the cost?

Mar: We have through those monies changed a lot of people who used to be pure disciplinarians into at least entertaining the thought that interdisciplinary work is touchable. The other thing is that we've created a group of this kind of people that can judge each other's work. Before, there was a total vacuum. I don't think you could get a decent review, an evaluation of whether something was good or not. Now you've created a huge human resource which can be tapped and made productive. Prior to that time, you didn't have the human resource. If you're willing to count that as a tangible output, I think that there's a lot more of that than any particular pieces of knowledge.

Neuhold: The evaluation isn't really complete yet. I'm talking specifically about the International Botanical Program effort. Something like $40-50 million has been spent on that particular program since its inception, and by the time it's finished, another two years from now, we'll probably have plowed fairly close to $60 million into that effort.

Some theories, and insights in the synthesis sense, that we have gained make that expenditure worthwhile. Had we waited, undoubtedly these things would have cropped up anyway over the years. My guess is that we've probably compacted the time from something like fifty years down to ten years of effort, and to me that's a worthwhile expenditure of funds. That is by no means all of the research output since, as I say, we're still not through the final process of synthesis. a lot more is expected to come out of it. When you consider how much it took to put a man on the moon for example, in terms of research and development funds in a ten-year span, we've gained a lot pretty cheaply. That's an intuitive evaluation, it's not based on complete information by any means.

Question: If someone did ask us, how would we quantify the benefits and relate them to the cost? It's extremely difficult in a way to ask for the benefit-cost evaluation to be done before research is undertaken.

Mar: You can always say that in any venture you have a learning curve. And on these interdisciplinary things the learning curve has its maximum deficit about four or five years out, and a lot of projects are cut off in their third year. IBP made it to five.

Neuhold: Seven, actually.

Mar: They're coming out now, they're being positive. But in a lot of these things you have to be willing to accept that risk, that there is a very costly learning curve that is probably very high for three years. Unless you're willing to wait it out past the fifth or sixth year, you may not get anything other than the people I suggested.

McCarthy: I don't have any comment on that because ours were all very short-term, and it's all learning curve for us. But I would like to ask John a question, and that is, in an operation that you're running with a variety of funding sources and a substantial amount of money, I'm curious as to whether you ran into the same problem that we ran into in one of our projects which has to do with the long-term versus the short-term payout. This brings you to this interminable excruciating discussion on the product versus the process. Do you have a problem with that, or did you resolve that?

Neuhold: I think we resolved it. We made a decision that we would not allow short-term efforts except in very special circumstances and then usually where they complement some of our other efforts, where they're probably necessary input to the other areas.

McCarthy: So you're not going to do any contract work?

Neuhold: Virtually none. We have some contracts but even they are fixed-price contracts, and we're involved heavily in the criteria setting, the specifications. If anybody wants to get into short-term work, he does it strictly on his own time.

Question: This may not specifically relate to the whole question of interdisciplinary research, but it's important to many people who are at this conference. Some agencies don't like funding university research because of the increasingly high overhead that universities are taking off the top. He quoted figures currently at 17 percent, which sounds ridiculous.

Neuhold: Well no, it's not, it's very realistic. What the agencies have to understand is that they're buying a lot for 17 percent. For example, putting a proposal together, the money necessary to put a proposal together, the released time of people is essentially an overhead cost. We've calculated in the Institute of Ecology, which is not at my academic institution but is a hemispheric-wide consortium of institutions, that we spend something on the order of one person-month for every $10,000 generated. This is a $25,000 per year person. So it's cost us about 10 percent of what we bring in simply for the time involved. This does not count the physical support facilities, all this sort of thing. 17 percent is not unreasonable. And if you take some of the organizations that work in these programs, the Battelle Memorial Institute for example, their overhead rates run at 130 percent.

Mar: This is one of the reasons we're running this NSF management study, to find out what it really costs to prepare an interdisciplinary proposal and then, what's worse, what is the cost to keep that team glued together while it's going through this learning process, which is a very expensive investment. Most of this has been bought in the past by a lot of agencies out of the hides of the faculty. We've had to work day and night to keep these things going and nobody has recognized it, either the funding agencies or the institutions that we're working for.

Question: Can you suggest ways in which this interdisciplinary research has been most fruitful and successful, not just in terms of cost-benefit, and also can you suggest any areas that are ripe and in need of it?

Neuhold: It's kind of an amorphous question because interdisciplinary work depends on the kinds of questions that are asked. One that comes to mind right now is the world food question. A lot of talk has been going on, a lot of dire predictions have been made about population increases and the question of world food, and what impact they will have on our environment. It is not a simple question, it's a very tough question. I was talking recently with people at Environment Canada, the Canadian environmental protection agency. They had established in their group an advanced concept center, which is staffed by a philosopher, economist, sociologist, ecologist -- a whole mix of people. Their job is basically to seek out those environmental questions which Canada as a nation is going to be facing 20 years from now. They found that one of the questions that was addressed to them was, "How large a population can Canada sustain and maintain its food independence?" They predict that Canada can produce enough food to maintain something like 38 million people. But if they grow to that level they lose their world position, they no longer have anything they can trade outside -- not only food, but also fiber, which is their main export item. They will be using all of that for themselves too, so they will lose their world trading position. So they've had to adjust that down to something on the order of 27 or 28 million. My point is that looking toward the future will identify those interdisciplinary types of efforts that have to take place. In this particular case, a single-order interaction, you are looking not only at demography, you're looking at economics, you're looking at the agricultural aspect, the timber aspect and so on, four areas all represented by an assortment of disciplines that will have to work out that particular question, just on that one-order interaction. It's that sort of thing that you'd have to look at in the future.

The other part of your question has to do with those types of interdisciplinary efforts that have gone on and solved some problems. The Department of

Defense has done a lot of this kind of thing, put interdisciplinary research and development teams together in the research to come up with achievements in armaments, strategy development, this sort of thing. NASA of course has done that for the man on the moon. Those are heavily interdisciplinary efforts.

Question: What kinds of projects have you been working on? Maybe that would give me a better idea.

Neuhold: One of our major projects is the desert biome. That particular project has essentially to do with bringing the ecological knowledge of the desert system up to a point where we can predict what will happen with different kinds of perturbations in that system. I've got about three efforts going on in aquatic ecology dealing with similar aspects. We're trying to bring our knowledge in aquatic ecology up to a predictive level. In geographic distribution, I've got work in the Aleutian Islands and in the Rocky Mountain region principally. We've got some projects in Egypt and Tunisia dealing with advancing desert systems. How can we predict, and what kinds of methods and management recommendations can we come up with, to forestall the advance of the Sahara Desert on the arable portions of Egypt -- things of this nature.

Mar: Let me try to answer that question. I've worked in a lot of disciplines, and I don't think you can say what problems you should focus on, or what solutions you have won. What I'd argue for is this: this symposium is about education; there's one educational aspect that we don't teach, and that's what I call academic tolerance. It's the ability to not go in front of your class and say, "Everybody that isn't one of us is no good." What we have to add in the educational system is just the acceptance by each discipline that the other disciplines have something to say. If we would do that and only that, we've got it made. You can pull your group together, you can focus them on any question you want, just like John indicated -- the only problem we have is communication, we won't talk to each other. I know it because I've had to work in it, and the way I operate is I beat them at their own discipline. You go in, print a paper in their journal, which is simple, you just have to figure what their criteria are and grind it through, and then they'll talk to you. That's ridiculous. Everyone has something to say on a problem and if we'd just listen to each other we'd go a long way toward solving it. So that's how I'd answer your question.

Question: I'd like to ask John Neuhold a question. How do you staff the interdisciplinary research projects? How many faculty do you have involved? Did you develop your own staff?

Neuhold: From the academic point of view, what I do is support people in resident departments. That is, I try to give the department the sense that they have a stake in the ecology program, not that the ecology program has a stake in them. In doing this, I'm then capable of interesting department faculty and department heads along with them in participating in my program. I have money that I can do this with. I have hard dollars that I can put into faculty, buy part of its time, help the department out in other ways. Generally speaking, in order to mobilize people into an interdisciplinary project you have to match two components: 1) a willingness to work and 2) the confidence which is needed. That's not easy to do. But as much as is possible with the faculty of 50 that I work with, I try to accomplish this, and with 50 people you've got considerable latitude in this area.

The faculty generally has split times in teaching and research.

From the federal point of view it's quite a different story, or from any kind of an organized research laboratory where the only responsibility is research. There, of course, the reward structure is set up so that you can reward a guy for participating in a program. Then it becomes a matter of simply matching personalities and getting people who can work together. There are some people who simply can't work with other people and you've got to recognize that and not try to bring them into those kinds of groups.

Question: You would prefer then, to mount an interdisciplinary program at an academic institution by utilizing the resources of the university, rather than by creating your own staff of interdisciplinary people?

Neuhold: That's definitely the way I'd prefer it.

Comment: You've got a carrot and you've got a whip. He's in an administrative position over people and in the other hand he has hard dollars to give them and they know that if he has the hard dollars plus the administrative position he's going to be here for quite awhile.

Neuhold: Yes, but you never want to beat a rabbit into eating a carrot.

Question: With these projects we have two responsibilities which are very clear. One is finding answers to questions, which is a commonly accepted university responsibility, and we package those things in Ph.D. dissertations, journal articles, and so forth. On the other hand, we have a transfer responsibility which is foreign to many universities. There is commonly no reward in the system for transfer because there's no journal article, there's no dissertation on the part of the faculty or graduate students. Now with your type of unit, how do you use the incentive system to stimulate a staff which will be there when the users want to use them, to make the transfers effective? Getting one step further down, when the users want to use graduate students they're someplace else. They have other responsibilities and probably are working with someone else.

Neuhold: That's a problem I'm wrestling with, and I haven't solved it. If you're productive in putting together systems which can be transferred, which can be addressed to a clientele of users, you can easily put yourself in the position of spending a lot of your time doing that transfer. It's important to make that transfer. Looking at it from the self-serving point of view, and maintaining a line item coming out of the state legislature, it's very important to me. On the other hand I cannot afford to put my faculty or my graduate students on that transfer process when their function is in fact getting the tools to work with. I guess one of the things we might have to think of is developing the extension type of individual that can accomplish that for us. That's something we've really not addressed. It's not without precedent. The agricultural experiment stations have been doing this for years, a century almost.

Mar: Well Jane, you might tell them how you have institutionalized the transfer process.

McCarthy: The experiment that we have now going on in Hawaii is jointly funded by the Ford Foundation and NSF. The Ford Foundation is paying for the transfer function. The reward system is built on the premise that the system is sufficiently popular, so that a line item in the Hawaii budget is probably coming through. People can see a very definite institutional financial link as a result of their direct participation in the transfer. They build very crude models, crude in terms of the academic community, to answer specific questions asked by the citizens of a particular geographic area in Hawaii, Kaneohe Bay, on various problems on the environment. What happens when a highway goes through? What is going to be the water runoff? It gets down to very, very fine things. If you build a junior high school, what does it do to a woman's backyard? They've answered some rather interesting types of questions and it's a very popular program within Kaneohe Bay. Those areas all transfer, and they're all out of the university through this laboratory which is called the Hawaii Environmental Simulation Laboratory.

Mar: I've watched them evolve, over time, and the tricks that they've used are two. The first is that as part of the interdisciplinary team they bring the client in, like state departments or local departments or citizens, they get to participate in actually doing the research. The other mechanism is that they've gone into the two-year colleges to hold that body of information. After you've developed it, then you transfer it there because that's where the citizens are coming back for continuing education. It's in that community group, and then you may end up training the community teachers to pass it on, and so you set up a progression which is a good model, at least. It's a model that has worked.

McCarthy: It's interesting. They started at the low level of pollution, in terms of geography. They're still doing that but they're now also on broader issues, the big policy questions that are being asked by the Hawaii legislature, on the carrying capacity of the area, and so on.

Neuhold: I have been experimenting with that same mode in the Rocky Mountain Environmental Research Project, which is a problem assessment sort of thing. We're of the mind, and so was NSF (RANN) that just doing a problem assessment, printing it in a book and putting it on a shelf someplace won't get you very far. So we're interested in seeing that the output of the project is implemented somehow. An effort is being made in implementation, and I have been using this technique of involving the citizen in the project itself, as well as the administrative types in the agencies that are in positions to affect and effect policy. In addition to that, we've designed an extension effort as a part of the project which basically deals with our output and transfers it to governors' planning offices, state legislators and congressmen from the area in regional seminars. Then there's a follow-up evaluation to see if we've been successful in transferring any of this. The thing that attracted me to the extension part of it was the follow-up effort to evaluate whether or not we were successful in the process. That's what appealed to me as a research administrator of the university.

Comment: We have a program in Massachusetts where the state Department of Public Works has hired the university to do certain of their own work. They've hired about $1 million a year worth of effort. One program is to assist in improving their impact statements. They don't want any research at all, other than state-of-the-art synthesis, but they haven't constrained the university at all. Basically they are hiring us to do their work for them because they don't have the people to do it themselves, but they do have money and I think this is the situation in which a lot of agencies are finding themselves. We're doing their work for them and so far they've let us do anything we want which they plug into a program. This is probably a program that can continue forever if the university wants it to, because the state will never have the people that can do the work it has to do. My personal feeling is that there's going to be a lot more of this. There's a lot of on-the-shelf knowledge that isn't being applied anywhere, it's just gathering dust.

Neuhold: If it becomes a part of the direct cost of a project to extend that particular project, I think the effort would be made, particularly if there is some kind of evaluation involved in the research.

Comment: At this time we're planning about 35 graduates. And I think next year the program is going to at least double. The Virginia Department of Highways has also almost completely transferred a great deal of its work to the University of Virginia. The interesting thing about it is that they expect from us innovative and imaginative ways to do the work, not just a bunch of warm bodies coming down and doing things the same old way. And that's basically what they're getting. So far they haven't complained about it. I see a lot more of that happening in the future. The agencies are sick and tired of doling out a whole hell of a lot of money every year for the same old thing. They're looking for new ways to spend their money, and I think that universities are going to have to find ways to focus more on this translation mode.

Neuhold: I'd like to comment a little on that. I think the question of transfer depends on what you're transferring. We do work with a permanent staff in the laboratory, and therefore we have continuity of people. We transfer a number of kinds of things and we do have part of the support staff involved, high level technicians and some of the tools we've developed, say in models and so on--we sell these in essence. These are the kinds of things that high level technicians can handle and transfer to eventual users so it isn't the senior type of people that are involved in this.

Another type of transfer is one in which we're now working with the Environmental Protection Agency, a project on the effect of coal-fired power plant pollution on terrestrial ecosystems or grasslands, in particular in Montana. Here we do involve a number of the senior people in the program but we look at this as an extension of the work in grasslands, and you can look at pollutants as a stress on the system. We're interested in stresses, so in a sense it's still in the area of fairly basic research. And yet we are transferring our expertise to an agency that has a particular problem to solve. I don't think there's a single answer to the transfer question.

The other point is that we are steering clear of what could be considered impact statement work. I guess I feel personally that this is not a university function. It's not the development of new information or new insights to any large degree. We've also had some private organizations coming to us, indicating that they wouldn't appreciate our getting into those areas. In other words, you do run into competition with privately funded organizations when you get into that area. And I question whether it's an area a university should pursue.

THE SOCIAL IMPACT OF ENVIRONMENTAL INFORMATION

Alan McGowan

It is a fundamental tenet of democracy that the people make the decisions. It is important to emphasize this well-worked point because it is all too often forgotten, and when remembered, abused. We remember all too well the abuses of the 1950's, when innuendo replaced information. We are also all aware of the rapid increase in recent years of the amount of information placed under military classification--necessary for certain defense reasons, perhaps, but certainly a situation in which abuse seems likely.

The existence of the information classification system of the Defense establishment--and the strength with which it is enforced--tells us something about the potential impact of information. Unfortunately, once such a system is established, it becomes extremely difficult to dis-establish, since it is discovered quite soon that the holding of information which another party does not have enables the holder of the information to wield a certain amount of power. The greater the information gap, the greater the difference in power.

Certainly it is true in the military sense. In time of war, the knowledge of military strategy is of extreme importance--the more one knows about the enemy, and the less the enemy knows about oneself, the stronger position one is in.

The question I wish to raise here is related to the use of information in a non-military, but perhaps nonetheless combative, situation. In other words, can information--or the lack of it--be used as a weapon, and if so, how? More importantly, perhaps, is the question of what are the issues raised by the use of information as a weapon. My thesis is that information--or the exclusive ownership of information--can and is used as a weapon, and such use constitutes one of the most serious social issues of our time.

Consider a recent example. Vinyl chloride has been much in the news recently, as word of its extreme toxicity and carcinogenicity became known. A recent two-

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part series in the Wall Street Journal, however, tells us that in fact the toxicity of vinyl chloride has been well known for some time--although not to the workers in the plant--and that the chemical companies knew for six months that Italian experimenters had shown that rats develop tumors when exposed to low levels of vinyl chloride.

Vinyl chloride is used in the manufacture of polyvinyl chloride, called PVC, a substance which has found increasing use since the end of World War II. By the 1950's, the Wall Street Journal points out, most American households contained many products, such as containers, phonograph records and curtains, made from PVC. Five billion pounds of PVC are manufactured in this country annually.

Vinyl chloride is made from ethylene, a petrochemical. The vinyl chloride is then heated in a pressure vessel and polymerized--made into larger, more complicated molecules--into polyvinyl chloride. There are many places where a worker can be exposed to the chemical, including climbing into the vessels to clean them periodically.

The first known discovery of the link between cancer and vinyl chloride, as so often happens, was made by accident. A Dr. John L. Creech, of Louisville, Kentucky, had for years treated workers at a plastic factory which made PVC. He had been concerned for some time about the number of factory workers who had liver disease; when he discovered that two workers in two years had died of angiosarcoma of the liver, an extremely rare form of cancer, his suspicions were aroused. When a third worker died of the same cause the same year as the second, the danger was clear.

The third worker died December 19, 1973. Researchers in Italy, however, had discovered by 1972 that 250 parts per million of vinyl chloride produced tumors in rats. The industry standard at that time, with the exception of one company, was 500 parts per million. Even though this was known to American manufacturers in early 1973, the secrecy with which they were given the data prevented them from disclosing the information. As a result, government agencies, company doctors and workers exposed to PVC were kept in the dark.

When the human cases of angiosarcoma were announced, however, the resulting publicity sent tremors through the industry, as threats to close the industry down circulated. The Occupational Safety and Health Administration has now set a standard of 1 part per million averaged over eight hours, one five-hundredth of the industry standard observed previously. It should be pointed out, however, that one company did lower its standards to 50 parts per million some time before this incident after some earlier questions were raised about vinyl chloride toxicity.

We must remember that the workers, and even the company doctors charged with maintaining some kind of health standards for the company's employees, were not aware of the demonstrated carcinogenicity of vinyl chloride. As a result of this information gap, they were unable to do anything about the conditions under which they worked. It must also be pointed out that by 1945 vinyl chloride was known by some to be toxic; it was rejected as an anesthetic during World War II because it caused heart irritation in animals.

This is, unfortunately, an example of an all too common practice, particularly in occupational health and safety concerns. Here, the companies were able to gain a political and financial advantage--albeit this time for an admittedly short six-month time period--by withholding information they had as to the toxicity of a chemical to which workers were being exposed. It is also worthwhile pointing out that the impact of the information, once it was released, was dramatic and immediate. In any event, the allowable levels of exposure to a dangerous chemical were quickly reduced by an order of magnitude on the basis of information made available to the public and to the workers involved. After further tests results were released, the OSHA further reduced the allowable levels to 1 part per million for an eight-hour period. The plastics companies claim they cannot meet the standard and that trying to do so will be prohibitively expensive.

One might well ask why it took until 1972 for researchers to test for the carcinogenicity of a chemical in use since 1945, especially one that was known to be toxic. In this case, the information was not available to the population most involved--the workers in the plant--because no one had taken the time or effort to investigate the question. After the information was discovered, it was withheld for a short time, again keeping it from the population most involved. The end result was the same--hundreds of people exposed for a considerable period of time to levels of a toxic chemical that is likely to cause cancer in many.

Another recent and serious example of the impact of information--or the lack of it--is involved in the question of how the nation is going to meet its need for energy. The Scientists' Institute for Public Information has for some time been involved in alerting the public to the serious environmental and safety hazards of nuclear power. Despite the much heralded report on reactor safety headed by Dr. Norman Rasmussen, touted by the AEC as demonstrating the near absolute safety of nuclear reactors, there remain serious questions as to the real safety of such devices. When it became clear that the continued reliance on nuclear power for much of the nation's electricity supply demanded a method to produce more fuel--since the uranium for the present reactors was in short supply--and the AEC's answer to this was the complex and dangerous "breeder" reactor, there was cause for some concern. But, they reasoned, there was simply no alternative, since fossil fuels were running out at some point, and we had to develop alternatives. The conventional wisdom at that time--about three to five years ago--was that solar energy would be nice if it were available, but that the technology was not available at the present time for its rapid development. As recently as a year ago, an NBC White Paper on energy dismissed solar energy as being almost totally impractical for current use.

Since we in the Scientists' Institute have always believed our job to be making sure that all of the facts were before the people so that they would have adequate alternatives from which to choose, we decided to investigate this claim in a thorough way. We had learned long ago that since the world was ours, it was too important to leave to the experts. We felt we had to find out really what was known about solar energy, and what people competent in the field felt about its use, ignoring the conventional wisdom as reported in the lay press and put forward by the AEC.

The specific motivation in this case was the preparation of comments on the environmental impact statement of the AEC's whole breeder reactor program, an impact statement forced by the successful pursuit of a suit against the AEC by the Scientists' Institute and the Natural Resources Defense Council, a public interest law firm which prepared the case. One of the requirements under the National Environmental Protection Act (NEPA) was to explore the feasibility and environmental consequences of alternatives to the proposed program. In their statement, the AEC claimed that solar energy was not sufficiently technically developed to be an effective alternative to nuclear power, hence the need for the breeder. When we investigated the matter, we found that the AEC had deliberately withheld information pertaining to reliable estimates of the feasibility of solar energy - information which was detrimental to their case for the breeder reactor. On December 1, 1973, the chairman of the AEC, Dr. Dixy Lee Ray, had submitted to the President a report entitled "The Nation's Energy Future." To provide the information necessary to the report, she convened a series of sixteen subpanels, of which one, subpanel IX, was concerned with solar energy. It was headed by Dr. Alfred E. Eggers, of the National Science Foundation.

The report of this subpanel, which took all of the available information on solar energy, including two massive "state of the art" studies commissioned by NSF, was exceedingly optimistic about solar energy. The following table, taken from the written testimony of the Scientists' Institute on the breeder program, compares the estimates made by subpanel IX and others with that made by the AEC. In every case, the estimates are considerably more optimistic than those of the AEC.

Largely through the aggressive efforts of members of the independent scientific community, the situation appears at present to be changing, and in fact provides an example of the impact of accurate, up-to-date, objective information. Although many people still think of solar energy as unattainable in the near future, a recent issue of the American Legion magazine tells the story of the

A Summary of the Potential of Solar Energy for Electrical Generation According to the LMFBR Environmental Statement and Other Estimates

Possible Solar Energy Contribution	(a) LMFBR Draft Environmental Statement	OTHER SOURCES		
		(b) Report of Subpanel 9	(c) NSF/NASA Report	(d) Mitre Corp. Report to NSF
In the year 2000 (as percent projected U.S. electrical demand)	(e) No "measurable contribution"	21%	(f) 5%	(g) 8.4 - 14.7%
Ultimate (as percent projected U.S. electrical demand)	(h) minor	100%	100%	100%
Could Solar energy be economically competitive by 2000?	(e,i) "Little potential"	Yes	Yes	Yes

Notes:
(a) Draft Environmental Statement, Liquid Metal Fast Breeder Reactor Program, March 1974.
(b) The report of one of 16 subpanels convened to make recommendations for Dr. Dixy Lee Ray's report to President Nixon, The Nation's Energy Future, December 1, 1974.
(c) NSF/NASA Solar Energy Panel, Solar Energy as a National Energy Resource, December 1972.
(d) MITRE Corp., Systems Analysis of Solar Energy Programs, Report #MTR 6513, 12/73.
(e) "Little basis exists for projecting a measurable contribution of solar energy to either electricity generation or high energy fuels since even optimistic projections of cost place solar conversion in a poor competitive position relative to coal or nuclear energy." LMFBR Environmental Statement, Volume IV, p. A.5-22.
(f) p. 10
(g) See MITRE report p. 120 which gives this value as percent total energy demand. This value has been converted to electric demand using data from: U.S. Energy through the Year 2000, U.S. Department of the Interior, 1972. Table 4, p. 16.
(h) "Thus, the conclusion is drawn that the use of solar energy will not materially reduce the need for alternative electrical energy sources in the foreseeable future." LMFBR Environmental Statement, Vol. IV, p. A.5-34.
(i) "The outlook appears to be that solar energy has little potential as an economical, major source of electricity for several decades." LMFBR Environmental Statement, Vol. IV, p. A.5-34.

AEC's efforts to cover up the validity of solar energy, and concludes that solar energy might be a much more important part of our future than we once had thought. And Forbes magazine, hardly known for radical or far-out statements, led off its October 15, 1974 issue with a story "Solar Energy - Suddenly it looks as promising as nuclear." This is hardly the assessment of solar energy being largely way-out technology and nuclear energy being the necessary wave of the future that had been prevalent just a few months before.

In these examples there is the connecting thread of withheld information leading to faulty conclusions and false impressions. In the one case, workers thought they were safe crawling around in vats where they breathed vinyl chloride vapor, when in fact they were exposed to a deadly chemical. In the other, there was a general impression that there was no real alternative to nuclear energy, and that therefore we had to be mortgaged to this dangerous and expensive future, when in fact solar energy was and is a reasonable hope for a significant portion of our future energy needs. The disclosure of the information produced decisive changes in direction; the legacy of failing to produce the necessary information when it was needed, and then actually withholding it once it was produced, will be with us for some time, in the form of workers fatally and unnecessarily stricken with cancer, and with a millstone-like nuclear energy capability around our necks.

COMMUNITY, PUBLIC SCHOOLS, UNIVERSITIES--A STATEWIDE WATER QUALITY MONITORING SYSTEM

Tom Offutt and Alison Kerester

TOM OFFUTT:

An experiment was initiated in Ohio in the spring of 1974 that has grown into a statewide project with national applications. The partners in this project include five state universities, the state environmental regulatory agency, thirty school systems from fourteen counties, the U.S. Environmental Protection Agency and the non-profit Institute for Environmental Education. The project is designed to provide university graduate students, high school teachers and their students with the opportunity to investigate significant community concerns, to serve the community and to develop career skills in environmental protection. The philosophy of the program is based on the assumption that when students investigate a problem that affects them they will apply the hard sciences as tools in order to understand the problem and then use social sciences as instruments to effect responsible change. The program creates an opportunity for this philosophy to be tested in a limited way as part of an existing school curriculum.

For years students have conducted water pollution investigations. Many of these programs have been outstanding educational successes but in even the most successful, the same questions arise: Does testing for water pollution make a difference in water quality? Is student-generated data accurate and useful, and if it is, why isn't someone paying for it? Does the responsible regulatory agency really care about what students are doing? The Ohio experiment focuses on answering these questions--in the affirmative.

In October 1972, the Congress passed into law an important bill which amends the Federal Water Pollution Control Act. Much attention has centered on the punitive aspects of the Act with little notice made of its pervasively constructive theme. Provisions in the first section of the act mandate public participation. The Act also requires states to submit annual inventories of water quality and to conduct a statewide monitoring program. Public participation appears as a consistent theme of the act.

Tom Offutt is Project Director of the Ohio Statewide Water Quality Data Development System and Vice President of the Institute for Environmental Education, Cleveland.

In Cleveland, Ohio the Institute for Environmental Education (IEE) has been administering the Cuyahoga Heritage Project, a National Demonstration Project of the U.S. Office of Technical and Environmental Education. This Project has grown from eight years of experience in training teachers and students in skills of water pollution investigation. The Institute asked Dr. Ira Whitman, Director of Ohio Environmental Protection Agency, if students could be considered "public" and did Ohio Environmental Protection Agency really want their "participation."

The answer was a resounding and enthusiastic "yes!" This response was echoed by the Academic Training Office of the U.S. Environmental Protection Agency, by Region V of U.S. Environmental Protection Agency and by EPA's National Training Center in Cincinnati. A presentation was made to the Ohio Board of Regents Inter-university Committee on Environmental Quality. This group, comprised of a representative of each of Ohio's thirteen state universities, added their support by co-sponsoring a proposal to fund the project. Five universities also co-sponsored the proposal and agreed to pilot the first year of the Project. These universities, Bowling Green, Cleveland State, Ohio State, Ohio University and Wright State, contacted schools in their immediate communities, a proposal was written, submitted, funded and the easy part of the program was complete.

Basic to the program has been the requirement that only those teachers who look upon the program as an opportunity should be involved. Most teachers welcome the exciting educational opportunities that real experiences bring students, and thirty-five teachers from twenty-nine schools joined the project. Efforts to develop an acceptable standardized data collection system could now begin in earnest.

Success of the system depends upon its being of benefit to all participants. These are the benefits to each:

Ohio EPA

1. Reliable statewide water quality data at a low cost.
2. An "early warning" system.
3. An involved and knowledgeable citizenry.

Co-sponsoring State University

1. A constructive working relationship with local high schools.
2. An opportunity to serve local teachers with in-service credit.
3. A graduate program providing experience in a variety of schools.

Cooperating School Systems

1. An educational project that links the schools to the community.
2. An operational component for an environmental science curriculum.
3. Parent support, teacher enthusiasm and student involvement.

The Teacher

1. Students excited about "learning" because "they need to know".
2. Association with other teachers that share a concern for the environment.

3. Sophisticated equipment not usually available to a classroom teacher.
4. Graduate credit, both in-service and summer.

The Student

1. An opportunity to both explore a problem and perform useful service.
2. A chance to apply academic experience to a real situation.
3. Skills that could lead to a career.
4. Students from other schools with a common concern.

The mechanics of the program are simply stated: students from schools near a university test regularly, at specified sites in their community. They use equipment provided by the state regulatory agency and techniques approved by both the state agency and U.S. EPA. The teachers receive training from the Institute for Environmental Education. They build kits to carry the water chemistry and bacteriologic testing equipment. The kits, with chemicals and glassware, cost about $60.00 and produce data that is accurate and standardized to standard methods specifications. The data will not be used in litigation but can serve as an early warning system. The regulatory agency is thus alerted to make its own investigation. The data will become part of the national water quality data system called STORET.

In the first year students are testing for dissolved oxygen, flow, total coliform and in some cases for fecal coliform. Other parameters will be added as more equipment and training become available.

The University provides technical assistance and a graduate student. The graduate student coordinates testing, data collection input, provides the shared equipment and assists the teacher in the field and lab. In most cases the teachers are enrolled for credit in the University. In all cases there is a monthly meeting where all parties come together to coordinate, plan and train.

The state regulatory agency supplies the equipment used in the testing. In Ohio the agency retains ownership of the equipment, but the equipment is specifically designated for use by the participating schools and is in the custody of the graduate student. Personnel from the nearby Ohio EPA District Office provide an essential link. They check the accuracy of the data, consult on sampling locations, assist in solutions to technical problems and help identify each sample site with an appropriate computer input identification number.

U.S. EPA's National Training Lab and the Region V Office of EPA have cooperated in every way to see that standardized, acceptable techniques are used. Institute for Environmental Education training cadre received instruction at the National Training Lab and Region V assisted in production of a "dissemination document" which explains the mechanics of the project. Both of these offices and the Academic Training Branch of EPA assisted in development of a set of audio-visual materials that supplement field work in the training programs.

The Institute for Environmental Education coordinates the project. Teachers and students from Cuyahoga Heritage Schools conducted a two week training program for teachers and students from the participating schools across the state. Supplies and equipment for testing are provided every two months. Training materials have been prepared and are available through the Institute.

Plans to test the model developed in Ohio are being explored in other parts of the country. The Chesapeake Bay Foundation in Annapolis, Maryland and the Environmental Education Center in Portland, Oregon are making plans to introduce the program on a watershed basis with their regulatory agencies in 1975. The American Revolution Bicentennial Administration has recognized the project as a Bicentennial Program and it is hoped that during the Bicentennial year other states will join the project.

ALISON KERESTER:

My name is Alison Kerester and I am a freshman at the University of Wisconsin-Green Bay. I have been involved with the Institute for Environmental Education and activities relating to environmental education since I was a sophomore in high school.

My involvement and work with the Institute for Environmental Education cover a wide range of learning experiences. Workshops, training sessions, travel, and publications are some of the out-of-the ordinary educational experiences that I have been able to participate in.

I was first introduced to environmental problems and the Institute for Environmental Education during a workshop held at my school during my sophomore year in high school. The workshop was held to investigate the water quality problems of a nearby brook.

The investigation of this brook sparked my interest in environmental education and the kinds of activities that I.E.E. was doing.

That spring I was asked to be a staff member at an I.E.E. workshop being held at Edinboro State College in Edinboro, Pennsylvania. Edinboro Lake was the subject, and after a brief introduction to the background history and geology of the lake, all three hundred participants divided up into teams and started investigations.

Alison Kerester, a freshman at the University of Wisconsin-Green Bay, has participated in environmental education workshops throughout the state of Ohio and elsewhere. She has had two articles published, and has received the Presidential Merit Award for Environmental Protection.

My job, as a staff member, was to help people become familiar with membrane filtration techniques in analyzing the bacteriology of the lake. We collected water samples in the morning and ran tests in the afternoon. A wrap-up session followed the afternoon of lab work. Using all the data that we had collected to grasp a total outlook on the lake, we discovered that it was like trying to put a puzzle together; many of the pieces were missing and many did not fit.

Although I have done most of my work in water pollution, in the form of staffing workshops and independent research, I am also interested in the urban environment. The East Cleveland Board of Education asked I.E.E. to take 120 fifth-grade students out of the classroom and introduce them to their community. Together we picked four aspects of this progressive urban community to explore.

In order to introduce the children to areas outside of their home territory, we decided to take them on the Cleveland Rapid Transit system, which transects the City of Cleveland and serves as neutral territory. Many of the children hadn't been more than 4 or 5 blocks from their homes in their entire lives and consequently viewed their school, their area, as a kind of territory. Anybody outside that was an enemy. The rapid transit system wasn't threatening. We developed a program for them and they helped with this also. They decided that they would like to interview people on the rapid transit. First of all we practiced. They made up a list of questions and they practiced on each other. Then we took them on the rapid transit. I had a tape recorder. They would say who they were and where they were from, and ask permission to ask questions. They would ask people what they would do to make Cleveland a better city. Besides doing that, we would get off at the rapid transit stops and the children filled out little information sheets, for example, environmental awareness sheets. What was the most dominant color in the area? How many broken windows? Just so they could observe. We also got support from the city. We took the children one day to the head of public relations for the Cleveland Transit System and the children presented what they were doing. The public relations person was enthusiastic and this encouraged the children.

This past summer was an exciting and busy one for me. I participated as a staff member in the first series of workshops intended to initiate the Statewide Water Quality Monitoring Program. Five state universities and surrounding high schools were involved in a series of workshops held throughout the State of Ohio. During the course of these training sessions the participants became familiar with five parameters necessary for collecting water quality data.

The month of August was spent working at EXPO '74 in Spokane, Washington. I worked at the Environmental Symposia Building with a group of students. We had a porch off of the building where we ran mini-workshops on water quality and displayed equipment and curriculum materials.

It was an exciting experience working at EXPO '74, sharing thoughts and ideas with teachers and students from across the country and Canada.

Working as a teacher in a workshop, while still being in high school, was a rewarding and often frustrating experience. I was learning while I was teaching. Being able to spark someone else's interest in an area that concerned me, and dealing with the resentment of some teachers over the fact that a high school student was trying to teach them a new way of looking at their environment, helped me shape many of my values and goals.

I feel that students should be given the opportunity to take the responsibility for their own education upon themselves. Many students have not been able to have this opportunity and, as a result, are used to viewing their environment in terms of the categories set down for them in the classroom.

As I continued my work with I.E.E. and as my interest in environmental education and environmental problems grew, I realized that other students besides myself were having difficulty in applying what they learned in the classroom to real community and environmental problems.

I chose the University of Wisconsin-Green Bay because it gives me the chance to continue the work I've been doing, which is important to me. It gives me full support for coming to conferences such as this. It also gives me the chance to take responsibility for my own education, which I feel is very important. I'm planning a career in environmental law, and am going to develop my own major, my own concentration, trying to coordinate subjects and courses that I feel will aid me in environmental law. I'm going to concentrate on environmental science but I would like to get a broad spectrum in economics and other courses. The university gives me this option. I'm also going to be applying for credit based on the experience I've already had in environmental education. This is another advantage of Green Bay.

DISCUSSION

Question: Are you a resource for expert witnesses that appear in environmental lawsuits? How does that work?

McGowan: If you ask us a question, for example, I need X person to do Y thing in this area, we will try to find you somebody who is close by. Then, sometimes if it's a particular thing, we'll find you somebody that may have to fly from New York, because you have a specific need on a specific thing. We have people testifying at non-judicial hearings as well.

Question: What is the nature of your information work? How do you find people?

McGowan: We usually make a lot of noise and then people start coming to us. We find people by organizing local groups. And it's amazing--wherever we go, we find that people are eager to do things. They have all this training. We find lots of people who work for industry. (The same thing even applies to academics, but there's a little bit less of it.) They want to do something and they feel constrained. We don't take positions; we just tell it like it is. We give out the facts. If their companies don't like it, that's their problem, not ours.

Question: I get the impression you fight fires. Do you have ongoing programs where you anticipate problems and try to present all alternatives? Or do you go from one crisis to another?

McGowan: It depends. We do have ongoing programs. The energy task force has been in existence for five years. We're just publishing a book which is the result of a two-year study and does present alternatives. We do, oftentimes, fight fires because of the nature of things and because, you know, we're a lean, hungry organization, and if fire comes you have to fight it. We're right in the middle of this kind of thing now, because the Rasmussen Report took two years and cost two million dollars. We have about 8 weeks to comment on it. So, we have ongoing programs in the middle of which there are crises.

Tom Offutt was the moderator for Session 10.

Question: Have you done anything on lead from smelters, as in Idaho?

McGowan: We don't have a group in Idaho, I'm sorry to say. We should have one, and the lead is a serious problem, from what I know about it. It ought to be attacked vigorously because the evidence that we have (we've worked with lead paint poisoning in children in St. Louis and New York) shows that even low levels are extraordinarily dangerous. You can't tell what the levels are, either by urine tests or by blood testing. You've got to do either bone marrow testing or testing of teeth to determine the real impact of lead because the lead level in blood will go down after about six hours. That does not indicate that there is no problem. The lead deposits in the bone marrow and also in the teeth. That gives you an idea of the problem.

Question: What effect will the disbanding of the AEC and the division into two new bodies have?

McGowan: The Atomic Energy Commission for the most part has not been disbanded. The only significant thing that has happened is that the regulatory function has been dismembered from the promotion function.

My own feeling is that that was never the real problem with the Atomic Energy Commission. That was what everybody said, and they attacked that and so that was spun off. The real picture will be shown with the passage or non-passage of the non-nuclear energy bill which is now before Congress. If that gets passed with significant funding levels and then the money gets appropriated, there will be a chance of doing something. But the problem has been, and it's the problem with the Solar Energy Bill that just passed, that NASA gets all the money to develop solar energy. Well, there's a fundamental difference between developing solar energy for use in outer space where you want very light weight, therefore you're willing to spend $2,000 a kilowatt to produce it, and producing solar energy for use in a home or in a power plant where you have to get it down to about $50 a kilowatt. The wrong people have been getting the money to develop solar energy, aside from the fact that there hasn't been enough money.

Question: I'm working with a program where we're trying to teach children investigative techniques, even as young as a preschool and kindergarten. I would like to have your ideas on how to convince your basic everyday school district, your basic everyday classroom teacher that this is a valuable lesson.

Offutt: I think it's critical that you don't try to change the teachers, but that you try to identify the ones that want to do this and work with them. There are enough teachers that really want to involve their students in investigations of their community or their environment, so that you can have real success in working with them. Finding those teachers is a difficult problem. You go into the buildings and you talk to the faculty meeting, or you try to talk to them somewhere else. The first steps are always the hardest.

The way it has worked in Ohio is that we were asked by the state to expand our Cuyahoga program statewide. We did that by identifying the state university in the first case that was interested in working with schools in its immediate community. It was not very difficult to identify a professor at that university that was interested. In almost all our cases he knew of students of his that were teaching in schools in the community, teachers that were hungry for the opportunity to get into investigative community problem solving. That's how it happened in Ohio.

McGowan: I would disagree a little bit. We've had some very interesting experiences. We would take teachers and students and involve them in a situation where they had to cope with interesting situations, and where the teachers were able to see for themselves the things that youngsters could do because students were doing them right along with the teachers. Once that realization was there, and once there was the motivation to do something, many of them went out and really started blazing trails.

I think the other thing you have to do is to give people support on how to fight school administrations and school boards, and how to work with parents. It's not easy because education is an entrenched bureaucracy in many places. You have to develop support systems for people who are doing that. And it's very important to have examples of programs that have worked, workshops or whatever. When a teacher gets something working in one school district, an adjoining school district would like to see that it works there, so they can get superintendent support.

Offutt: I think in terms of very narrow support systems and narrowly focused activities. And I think that was one of the most important things about the program with the fifth-grade East Cleveland children. They never have had an opportunity to talk to anyone outside of their family or school. This started the investigative process for them. Talking to somebody that they'd never met before, finding out what they thought, telling it back to Alison on a cassette--they were taped, it made it important, and then they came back to school and heard what everybody else had to say. Alison gave them suggestions on how to get better information on the next interview. Then they had to write this up so that they were actually learning to communicate, and it was important and it related to their needs.

Question: There is in my area of Long Island, a well-known biology teacher who has somehow hit upon the knack of taking advantage of opportunities that fall in his lap and making them into whole curriculum units.

One of the students found an owl that was shot on Christmas Day and they eventually worked that up into state legislation protecting owls. They found a dead whale on the beach and they went into a whole investigation of whales, their life cycle, their anatomy, how they are being destroyed, and problems of how to protect whales. This was originally biology. Then last spring he phoned me and said, "You know, I've hit upon something that's really bothering me and I've got to get it out. I'm discovering that my students are leading me more and more out of biology and into understanding the community. I am inventing something called community-based education. We need to do something about that, hold a conference, publish a magazine, form a national organization..."

Now you seem to be talking about community-based education. What do you think of his idea of some kind of exchange of curriculum, how to do community-based education, the nitty-gritty of this as a teaching device, a regular standard method that you can teach people who don't know how to do it as naturally as he did, there are few people as talented.

Offutt: That's what I mean about this delivery system. One thing the Ohio program does, it gives an opportunity for people like this teacher to get together. And being together they are far more powerful and they can really make changes. There's got to be some value shown to the community, to the educational system, to the superintendent, to everybody for what these kids are doing. The same old thing of sitting in a classroom isn't going to hurt anybody, as somebody said today. But going out into the community is risky.

Question: I'm interested in how you got past that first gatekeeper. The fact that the EPA people accept the data gathering the students were doing is sort of incredible.

Offutt: First of all, if the data isn't being used for legal purposes it makes it easier. PL 92-500, the Water Quality Act Amendment of 1972, requires that every state put together an assessment of the state water quality. It's also required that there be citizen participation in this. Are high school students citizens? That's the first hurdle. And if they are, then they can participate in the program, if they can receive very simple training in doing these tests. The dissolved oxygen test doesn't take four years of graduate training. So as long as it's supportive, positive data, information upon which plans can be based, upon which reports can be submitted, that's fine. If it has to go in litigation, I wouldn't want the youngsters involved in it. The information does provide an early warning system for the state. There are monthly meetings with the EPA people and the teachers in each one of these universities, at which the data is all put together and handed over. The problems are discussed, and at that time, we might say, we're finding these levels, consistently in this particular tributary, there's this municipality, industry, trailer court, whatever. Then it would be up to the EPA to make their own investigation and take action.

Question: What's been your experience with that?

Offutt: Very little. We've had three years on the Cuyahoga, three months on the statewide program. On the Cuyahoga, we've had one case in which a building ban was slapped on the city as a result of a student alerting the EPA about his data. We haven't gotten into it any more than that.

Question: How are the participating schools made to feel that they're part of a statewide program. What's the feedback mechanism?

Offutt: I didn't want to get into all the complexities, but it's extremely important. The data that is developed and fed into the EPA is reported back to the students as part of a package on their watershed, so that they see how their work relates to everybody else's work. That's done through the state EPA.

There are two statewide meetings that have been written into the proposal so that everybody gets together at the university. The university is giving the teachers in-service credit for what they're doing. That's another support link.

The students see how it all fits together, and they see that it's real and it's needed, that they're really doing something.

Question: I wonder if you'd comment on whether this is generating personal involvement of the student in environmental activities, other than the academic involvement.

Kerester: First of all, there was the frustration. When I said the school gave me support I was talking about one teacher in my high school. She gave me the kind of support I needed to do things, but it was very frustrating, not to be able to go full steam ahead--I had to do all this other stuff. Now I feel able to breathe at Green Bay, because I do have that kind of support. Frustration that produces change is one thing.

Question: Are there other students besides yourself that continued on?

Kerester: The two girls that got me started still have an interest in the environment but they are applying it, for instance, in medicine. The interest is still there. The approach that I learned, the interdisciplinary approach Green Bay focuses on, the approach I learned working with the Institute, can be applied not only to environmental problems. It's a method and a way of looking at things, and a way of learning how to think. That's important, learning how to learn, and teaching other people.

Offutt: There are 1300 students actively involved in the Cuyahoga Heritage Project in the 18 school systems in northeast Ohio that are working on that project. Some of them are peripherally involved and some of them are very, very deeply involved. We're primarily working on quality and the depth of it and establishing credibility.

Question: You've told us the success stories and only one failure, and it's nice to have a positive note, but it's also realistic to give some of the stumbling blocks that came up and left you frustrated. You owe it to your own intellectual and academic integrity to pass this information on to us so that we know what to anticipate when you come along and say, "Do this as a research technique. It may involve the loss of a number of jobs but their parents will support us I'm sure." What went wrong, did the students lose interest? You make it sound as if every two weeks is not too much to expect. My experience is, every two weeks is not too much to expect for two weeks. But after four months and six months the continuity of the program suffers.

Offutt: Obviously, we want to talk about successes and there's a good reason for that--we have learned from at least some of the failures, some of the mistakes that were made. And we have tried to build on the sometimes slim bed of success that runs through the program. But the one lesson we have learned is to rely on the students, and almost every time where we have had failures, it is because we have not relied on the students. And we have had successes where we have relied on the youngsters.

For example, we ran a program in the summer of '69 in New Hampshire and we brought 30 teachers and 30 students together. At the end of that program (it was three weeks) everybody went charging out to reform the world, and by the time three months had gone by we didn't hear from those folks any more. One of the reasons for that is that we did not develop the kind of support mechanism that was necessary to help them face administrative problems. The school board or the administrator or the principal would say, "No, you can't take students out of class, we're not insured for it," "We don't own the buses," etc. The failures have been where we have not relied on the students to give support to the teachers that they need in order to fight the battles that need to be fought. There are lots of teachers who have gone through programs of one kind or another and haven't done anything after they've gone through it. And there are lots of people who are frustrated. They can't get money to do the programs, to buy equipment.

One other thing is that there's got to be something in it for everybody that's involved. There has to be an honest, real payoff for the youngsters, the teachers, and for every party to this thing. It will fail unless there is something in it for everybody.

Question: Have you explored and interpreted any problems of more pristine environments?

Offutt: Just last week we were asked to stop in Helena, Montana to talk to the people there about a project in Montana. The initial reaction from the man in charge of water programs is that there are no water problems in Montana. But where you have people going to school you do have tributary streams, you do have local problems that can be identified. It's useless to do environmental tests on an area where the students aren't going to find anything. But I don't think you're going to find many streams like that.

Question: Does it come across to the students that there are such streams, that there are streams of varying quality? Sometime agencies give the impression that everything is bad. I wanted to be certain somehow in the elementary programs, starting with the fifth grade, or the secondary school program, that this balance is coming across.

Offutt: You're right. I've seen it happen with students that focus only on degradation problems--they feel, what's the use? Everybody breaks up and goes home. There's got to be this balance. And I think there is. But it isn't built into this program.

Comment: We built it into ours at Green Bay. We organize the schools on a watershed basis, and you select your schools or the schools apply to work on it. Make sure you have a cross-section from the top to the bottom of the watershed. By bringing them together prior to the sampling, and following them through the sampling and then collecting and analyzing and summarizing the data, you're usually able to show gradients on all of these streams.

Question: Is there any reason why this kind of concept couldn't be extended to really urban areas, where the students wouldn't be expected to go 20 miles out into the woods but are living in an urban environment and can study whole processes from within, such as measuring air quality, and looking at the greater environmental issues of urban planning, traffic flows, and so on?

Offutt: It has been done and it should be done. I would make some general comments in response to that question. If you ask a youngster in a city school system what problems he or she is facing or is going to face, environmental concerns are really way down on the bottom of the ladder. That is an issue that we must deal with. Those students are going to be faced with unemployment, for example. It is a challenge for environmental education to show the relationship between the high interest rate and environmental concerns. And if it cannot show that, then environmental education is a failure. It really must show the workings of society. That's what those youngsters are going to be interested in because they face it every day.

To some extent, we are having visited upon us the results of a failure to realize what was going on, the way that we had to move as environmental educators. This is an interesting year for lots of reasons and one of the reasons is that we are faced with a do or not do situation. Either we face these issues, or environmental education will go the way of lots of other things and turn into a fad, something that once was and now no longer is. It would be a very bad mistake if that happened. It's up to us, as practitioners of environmental education, to see that it doesn't.

Question: How can society find a way to consider early alternatives on what to do about a smelter, for example. What kind of mechanisms do we have, or what could be developed to start that kind of action?

McGowan: That's an interesting question. I think that we don't have the mechanism. And we are therefore faced with a series of seemingly unacceptable alternatives because we have not developed the mechanisms, and because we have not as a society decided that we're going to come to grips with some of these things before they develop into a confrontation situation with no acceptable alternatives. The interesting thing about the present time is that we are faced with a situation where we can make meaningful decisions. That is, there is a general understanding of a series of problems. My belief at this point is that unless there are some changes in the economics of energy production, the energy industry will not be able to hack it. There are indications that unless there are changes in the entire productive enterprise, it won't be able to hack it. We can learn from past mistakes and develop those mechanisms. But I think we are moving into a planned economy, no matter what we do. It's really just a question of who's going to do the planning, whether they're going to do the planning, or whether we're going to do the planning. And for my part, I don't trust them. I want to do the planning.

Question: How do you get that planning to be done by the general broad public? This morning it was mentioned that environmentalists are really elitists. What mechanisms do you see for getting a wider participation, having a wider impact?

McGowan: Part of it is simply to develop a certain kind of political sophistication among people who are interested in working on problems and in making changes. And by political sophistication I don't mean (although it may be partly that) knowing which committee is doing what thing, what bill, and where the appropriations come up. I mean a real understanding of how impact is made in society. Just like we say, "Trust the students to do things," trust the people. When people know what's going on they'll make the right kinds of changes.

Question: Have you seen the impact from your course, for example, rub off on the students so that they become actively involved in other areas, besides just doing their specific samples?

Offutt: Absolutely. I'm talking about the ones that are coming out of school and graduate school now and are beginning to make impacts in the community in the very real kind of a way, to apply the technology. They aren't keeping it to themselves in the lab, or teaching it to someone else so they make sure it stays in the lab, but actually applying it in the community.

McGowan: That is not to say that we have all the answers. I'm going to take issue with Tom. Tom says that the information should not be used for litigation, but that it's all right to use it for EPA. I don't see the difference, frankly, between data being used for litigation on the one hand and its being used by a state agency on the other. State agencies aren't all good. Some state agencies are pretty evil things as a matter of fact. I spend a good deal of my time fighting the federal EPA. So we have to be very careful. We have to establish a program where the students can challenge you as effectively as you can challenge them. When you can develop students that can tell you that you're full of hot water or hot air or whatever, then you've got a successful program, when they can understand the economics of the situation and begin to understand that maybe EPA answers to some of those industrial interests.

Question: One of the first things that happened in one of the first panel discussions of the conference was that two of the speakers emphasized the point that educators can't leave any value system with the people they educate. To me that really didn't make much sense, I mean, unbiased information. Either you are biased in one direction or another. Did you get a lot of bad feedback from parents and the community because of that?

Offutt: No, frankly. Maybe we should have. You're talking about values. Your values have to be developed as a result of having done something, that's what it's all about.. I think that the values that the students develop haven't threatened, and maybe that's wrong. But one of the things to remember is when you're dealing with a problem that is extremely complex, in most cases the agency that's responsible for it is trying its best on the local level, trying to do something. The constraints are understood, and the students can begin to appreciate the fact that environmental problems aren't simple and can't be simplistically answered or stated.

ENVIRONMENTAL ENGINEERING TRAINING PROGRAM IN LATIN AMERICA AND THE CARIBBEAN AREA WITH THE COOPERATION OF THE PAN AMERICAN HEALTH ORGANIZATION

Edmundo Elmore

On a continental basis, significant accomplishments are being made to improve environmental conditions in the Americas--and especially so with respect to the provision of water-supply and sewerage services. The continental water-supply and sewerage program is based on the simple rationale:

--That to satisfy human needs is nature's most precious substance;

--That community systems of water supply and sewerage are basic essentials to the health, economic and social well-being of peoples;

--That safe water, in reasonable amounts, available in homes, together with sewerage systems, will reduce enteric infections and related illnesses; will decrease infant mortality; will promote cleanliness of the person, the home, and the community; and will engender self-respect and enhance the dignity of Man.

Throughout the Americas, these facts are well established, well understood; and are endorsed and strongly supported by the people.

More recently, this importance of water-for-people and sewer-services-for-people was reaffirmed--and broadened to embrace related environmental needs--by the pronouncements of the American Chiefs of State at their Summit Meeting in April 1967 at Punta del Este.

The Governments of Latin America are responding aggressively and effectively to these challenges. In terms of monetary parameters, in the period 1961-1973 about 3.8 billions were invested for water-supply and sewerage works. Of this amount, 2.6 billions (about 66 percent) represents national funds--the remainder, 1.2 billion (about 33 percent) being loans from internationl agencies. In terms of the human equation, these improvements benefit 80 million people.

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A few years ago, it was quite apparent that the massive continental programs in water-supply, in sewerage, and in related environmental controls would require trained technical manpower in numbers and types far in excess of what normally might be mobilized--and would require service laboratories and related facilities not then in existence.

Responding to this need, aggressive actions have been taken on two broad fronts: First, strengthening schools of engineering (especially with respect to sanitary engineering curricula); and second, the establishment of a continental system of continuing professional education and a system for the training of sub-professional technical manpower. Both actions involve close collaboration with universities--and both have been extraordinarily successful.

The program for undergraduate education integrates sanitary engineering curricula into schools of civil engineering. This practice is now followed at 25 universities in Latin America. The programs for professionals and the training of technicians are receiving exceptional response from universities and government agencies. At present, there are 42 universities in 24 countries in the network--conducting 70 to 100 short courses per year and benefiting about 2500 professional and sub-professional personnel. The total expenditure for this program is $1.2 million per year, of which less than 20 percent is provided from PAHO resources.

Concurrently with the development of the education and training programs, the Organization is using its influence to stimulate graduate-level education for sanitary engineers at selected universities. At present, eleven universities offer graduate programs in sanitary engineering. An interesting by-product of these efforts has been the upward trend in full time faculty at schools of engineering--from less than 10 in 1962 to about 50 at present.

The third extremely important cog in the PAHO machinery for training and education is our newly established regional Center for Environmental Sciences and Engineering in Lima, Peru. In addition to its other functions, the Center mission includes a major role in the development of educational activities and of the applied research potential of the universities. It will assist member countries in establishing and developing educational programs and quality research and teaching centers. It will strengthen PAHO's present supports to the education and training network, as well as to undergraduate education; and it will provide stimulus for research training.

Session 11

WATER POLLUTION CONTROL IN THE FEDERAL REPUBLIC OF GERMANY

Hendrik Bebber

Water pollution in the Federal Republic of Germany is due to the great quantities of used water that is discharged uncleaned, insufficiently cleaned, or sometimes even poisonous. The burden has multiplied during the last few decades, exceeding the self-cleansing capacity of rivers and streams which have become increasingly befouled, often turning into sewers.

In many towns and industrial plants the cleansing of used water is poor. The reasons are that water authorities are overburdened, regulations are not being observed, and towns and industrial plants lack financial resources and government assistance to construct cleansing equipment and sewage systems. A tolerable water supply can be attained only if the water used in homes and industry which flows into public sewage systems or directly into waterways is cleansed and treated biologically.

What is needed to achieve this goal are new sewage systems for 14 million people, expansion and modernization of already existing cleansing equipment that now serves 13 million inhabitants, and the construction of new purification installations serving 25 million more people. This requires an investment of $2.3 billion for cleansing equipment and $6 billion for sewage systems.

In industries pumping their used water directly into waterways, the cost of building purification equipment and sewage systems is estimated at $1.7 billion. In addition to the cost of these remedies the increased use of new and steadily mounting quantities of used water must be met. The remedial program itself amounts to an emergency and must be completed within the next 12 to 15 years. If not, the waterways will worsen.

To make and keep the waters clean, $170 million must be spent annually on cleansing equipment and $430 million in sewage systems each year through the early 1980's. Industry alone must invest $130 million yearly in cleansing equipment. At present, funds expended for clean water are below these figures. There is no complete data on the investment necessary for the direct disposal of waters used in industry. One estimate shows that the $36 million spent by industry in 1969 is

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considerably below true requirements, even if this sum does not include investments without tax benefits or investments for water cleansing equipment in new factories.

Those who cause water pollution must be responsible for its elimination. The willingness of polluters to assume the cost of purification without any direct benefit to them varies from case to case. Some towns and factories have gone to great lengths to create good equipment for handling used water. Enlightenment and government financing must encourage motivation to do what has to be done, even in lagging towns and factories. Public resources can help spur investments.

Past neglect is not the fault only of those who use water and then dispose of it uncleaned. The states feel obligated to encourage the construction of purification equipment and expensive sewage systems, especially within the public domain. The federal government, too, has helped in the past few years to finance the construction of purification equipment, especially with credits, when towns or factories contribute a suitable sum on their own.

The annual water needs of the population of Northrhine-Westphalia total about 1.6 billion cubic meters. Industry draws several times this quantity from wells of its own, so that the total consumption of water in Northrhine-Westphalia is about 6.2 billion cubic meters annually.

The needs for drinking water are filled by water from wells, ground water, bank-filtered ground water, and surface water. Especially along the rivers Rhine and Ruhr there are sufficient supplies ensured by the availability of bank-filtered water. About 16 per cent of the demand for water is drawn directly from surface water. A necessary precept for maintenance of the water supply is, therefore, water pollution control and conservation of watersheds.

As early as in the 1920s pioneer work in this field was performed in the Ruhr district. It was realized that pure water can be maintained only through regional action, and the first cooperative water supply and conservation organizations (Wasserverbaende) were founded. Also, sewage treatment installations were erected and operated.

The legal situation in the field of water pollution control is similar to that in air pollution control. Here again the principle has been established that those causing polluted water to flow into rivers and tributaries must pay the costs of purification. Legislative authority is vested in the Federation partly and partly in the states. Major demands for surface water pollution control are also to be found in regulations governing planning. On the federal level the following laws are important in water pollution control: the water household act (1957); the law on detergents in washing and cleaning agents (1961); the inland waterway shipping rules (1966); the regulations on the erection and operation of installations for the storage, distribution, and transportation by land of inflammable liquids (1960); and the convention on the international commission for pollution control of the river Rhine (1963). Furthermore, in Northrhine-Westphalia the water act (1962), the regulations on storage tanks (1968), and the guidelines governing the protection of medicalspring areas (1968) hold good.

The extent of river pollution varies much. It depends on the concentration of industries and residential areas along specific stretches of river and on how intensely sewage and waste water is treated in local purification installations. The consequence is that it is not at all true that the heaviest degree of pollution is always found in the lower courses of rivers.

Aside from its provisions concerning air pollution control, the aforementioned "Northrhine-Westphalian Program 1975" also contains measures for improving water pollution control. It is hoped that in this way most of the rivers can be freed of at least the worst pollutants.

For the towns, this means levying taxes on inhabitants and factories to cover the costs. So far, however, financial aid and enforcement of water laws have not stimulated the construction of enough cleaning equipment to assure a clean water supply.

The North Sea and the Baltic Sea are being increasingly polluted, and little has been done about it. Federal regulations are valid solely in coastal waters, and international agreements prevent ocean pollution caused only by oil spills, not other injurious matter.

The growing pollution of the North and Baltic Seas by industrial waste is burdening the relationship of countries bordering the coast. The federal government will submit a bill for an amendment to the 1958 International Agreement on the High Seas. It will include the right to regulate waste and garbage disposal in the ocean and will urge immediate negotiations with countries bordering the North Sea, aiming at an agreement to keep the water clean.

A similar arrangement is indispensable for the Baltic Sea. The federal government strongly supports international efforts toward a worldwide agreement on keeping the seas clean.

The amount of usable water in many areas is far from sufficient to meet public needs. These areas depend on surface water, which is much more vulnerable to pollution than water below ground. The contingent dangers can be anticipated if the use of ground water is increased and improved, especially water obtained from greater depths.

It is difficult to determine precisely how much ground water is available. To obtain a reliable estimate, a measuring program should be developed in cooperation with the hydrographic services of the various states and through an exchange with American experts. The results would be processed in a data bank. A water research and development program should take into account the changing environment and living conditions in developing water resources. The program ranges from applied and particular research to the development of new technologies and the testing of model equipment.

Responsibility for developing the program lies in the institutes for water research of the federal and state governments, the universities and industries. It will include cooperative work on specific research subjects. The overall research and development program which covers work already under way will also include:

1) investigations on effects of pesticides, refuse matter, food, and polycyclical aromatic hydrocarbides,
2) investigations on the nature and scope of coastal water pollution and cleansing measures for maintaining coastal waters for health and recreation,
3) investigations on the effects of hot water discharges from thermal powerworks,
4) development of techniques for purifying used water, supervising and keeping waterways clean, construction and testing of model equipment for cleaning used water, artificial aeration,
5) investigations to determine the country's total water requirements, and
6) investigations on the probable development of water management until the year 2000 with the aim of forecasting needs and conditions far in advance.

The crucial points of future measures aimed at control of water body pollution will seek to control the pollution of the rivers Rhine, Ruhr, and Wupper. Made possible by state assistance from Northrhine-Westphalia to total 632 million DM during the next five years, these projects shall be carried out jointly with townships, communities, and water supply and control organizations.

The federal government, too, intends to take a more active part in the efforts to fight dangers to the environment to the extent that it possesses legislative authority, or is granted such authority by the states. Federal Chancellor Brandt recently referred to this task as one of the most important ones for the coming years. It is one of the five main points in the reform program of his Administration. The Federal Minister of the Interior characterized the reduction of the lead content in gasoline, a law on waste disposal, the improvement of the water household act, a water hygiene act, and a federal law on emission pollutants as the most pressing needs.

It is officially estimated that in the Federal Republic investments of 15 billion DM must be made solely for the erection of drinking-water purification installations as well as another 3.5 billion DM for the construction of garbage dumps.

If life in our cities and industrial centers is to remain bearable and attractive, such efforts to control air and water pollution are absolutely necessary. The inhabitants of these cities and industrial centers produce, surely, a major share of the social product, therefore, a sufficiently large part of that product should be spent in insuring that they live in adequate environmental conditions.

ENVIRONMENTAL EDUCATION IN SASKATCHEWAN AND CANADA

Fred Heal

I'm delighted to have this opportunity to come to Spokane and share some ideas with people from not only within the United States but from other countries around the world. This is a delightful experience, and there should be more opportunities for a wider variety of people to share in these kinds of discussions.

Before I get into a report on where we're at in environmental education in Canada, and specifically in Saskatchewan, I want to respond to a couple of things that I have heard over the past few days. The questions have come from several of you. Is there a cooling off in Canada for Americans? I think that Canada, like other countries, is looking at America and respecting and admiring to a great degree the progress and advances this country has made. I know that the number of opportunities that I've had from my educational experiences, the opportunity of meeting and working with people south of the 49th has been a very broadening experience for me. And this is the kind of thing that goes on to a very large degree. Scientific research goes back and forth across that world's longest undefended border at regular intervals. Training programs that the Environmental Protection Agency has been sponsoring for years at its laboratories in Cincinnati and North Carolina have attracted a number of Canadian water and air quality people. This training has gone back and forth, and I think has been mutually beneficial for our two countries.

Institutional arrangements have shown a good deal of cooperation. Things like the International Joint Commission, that body that tries to marshal the different concerns on water and water related problems between these two countries, have shown that cooperation between two different nations can work, and with a lot of good negotiation and a lot of clear-cut thinking can have some very positive results.

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I would say, though, that there is a feeling in Canada both of wanting to decide her own destiny and shape her own development. I don't think this is unique to Canada. Maybe it happened a little later in Canada than it did in this country, but it seems to be a rising voice today. This is particularly true in the area of resource development and management, and more specifically in the area of energy. All of you have heard both of continental energy policies and NAWAPA, which was going to divert major rivers in Canada, in the northern part of Northwest Territories and so forth, down into the Colorado Basin. Those kinds of discussions perhaps are not received with a great deal of enthusiasm in Canada.

Nevertheless, I think we have illustrated on a number of occasions that there are resources that can be shared on both sides of the border. It's a credit to Spokane and the people who are involved in setting up Expo '74 that they are creating a series of symposia. I've seen them over the past few months. We bring people together, people who have different perceptions, different perspectives, and perhaps different ways of thinking about life, and give them a chance for discussion and dialog. That will in the long run prove much more successful than going back to isolationist policies, which I hope doesn't happen in Canada.

Enough of the political ramifications -- where are we environmentally and in environmental education at this time?

Before you can get a real appreciation of the various differences between Canada and the U.S. environmentally, you have to recognize the constraints that our constitutional framework, the British North America Act, puts on federal - provincial relationships. Canada is a federal state. The provinces have a significant degree of autonomy under the BNA Act. Such items as ownership of natural resources are clouded by different degrees of legislative responsibility. For example, the provinces have, clearly stated in the BNA Act, responsibilities for oil, minerals, and natural gas development. Unfortunately, the whole question of management of resources has indirectly been affected by international and interprovincial trade, which is more or less a federal responsibility, and by taxation and revenue sharing. So while it may be clear cut that the actual land ownership lies in provincial hands, how the resources are developed and operated is affected to a large degree by federal legislation. This has given rise to a public debate in Canada over the past few months on the whole question of energy development, and who really controls the energy resources of the country.

What has been necessary in a national kind of activity, then, for environmental protection is the establishment of statutes and regulations which work for cooperation on a federal - provincial basis. The Canada Water Act, for example, provides for federal - provincial joint research, planning, and management of water basins. This has meant that agencies like Environment Canada which was established in 1971, I believe, to put some sort of finger on environmental protection in Canada, have not been able to operate unilaterally, but must cooperate with provincial agencies. This has a number of implications within the environmental protection field, but I want to say more about its implications for the environmental education area.

Education was one of those rights and duties that was clearly delegated to the provinces when the British North American Act was written. This means that we are unlikely ever to see a national environmental education act per se in Canada. Very little initiative can be shown at the national level in education in the country. We don't have the advantage, at least for the K through 12 programs, of standardized arrangements as you do in this country. For example, the province of Ontario has a five-year high school program. Other parts of Canada have a four-year program. The question of parochial schools and public schools varies from province to province. Regulations regarding examinations and courses taken, the degree of provincial control over education, differ tremendously from one area to another and it's very hard to give you an overall viewpoint of the whole country. There is a great deal of diversity. And there is, I think, a great deal of activity.

For example, in Ontario they have designed an environmental sciences course for their secondary schools. This takes a one-course approach which would cover the whole ambit of environmental education. Now in other provinces, for example in Saskatchewan, we've taken more of the integrative approach where you hope that the theme, messages, concepts, values and attitudes of an environmental education program can be incorporated through the existing courses in the school, and you don't really need to set up an entirely separate course.

I shouldn't leave the impression that the federal government has not gotten into the area of supporting environmental education, because it has on an indirect basis. There are a number of federal granting programs in Canada which emphasize student involvement and employment. One is called the Local Initiatives Program; another is the Opportunities for Youth Program. Both of these have been utilized by innovative teachers and teacher boards to develop some proposals and programs for environmental education. In other words, funding coming out of places like Manpower or the Secretary of State's Office has ended up contributing toward educational program development in some provinces where there are some pretty innovative teachers who see the opportunities. I can think of an example that isn't too far from here as a matter of fact, Ralph Shaw's Environmental Studies Center in British Columbia. Most of this was done through some federal granting programs in conjunction with his local school program.

There's also, as I indicated earlier, some interest in heritage, in nationalism, and this has provided monies for things which would lead toward more recognition of a national heritage and the different cultures in Canada. As a result of that, an educational program called Canada West, which was really a social studies program initially but with much broader implications, has gotten considerable federal funding for development of some interesting curriculum materials.

You see a fair amount of activity in Canada at the university level. I was very interested to hear Professor Albers' categorizations of the different approaches toward environmental studies in this country. I think that the Canadian experience is much similar. You have those institutions which try to work out coordinating programs between already existing agencies and departments. This is happening in a number of universities and colleges in Canada. For example, the University of Saskatchewan has an environmental studies committee which works with students coming in, trying to filter them into various classes, and tries to coordinate an operation where those classes in the different departments do mesh together and have some sort of environmental message. And you have another approach altogether at the graduate level of the University of Toronto where there's an entirely established faculty of environmental studies on a graduate basis.

Canadian universities, I think (and perhaps my friend from the University of Victoria may disagree with this) are somewhat more conservative in seeing innovations take place. Someone said the other day that getting a curriculum change was like moving a cemetery, and I felt this was very applicable to most Canadian institutions as well. It's exceedingly difficult. Canadian universities are somewhat more rigid and inflexible than their American counterparts. As a result you may not see the innovative approaches that you would see at the University of Wisconsin - Green Bay, or Huxley, or some of these very interesting happenings in undergraduate education.

I want to put my focus on Saskatchewan from here on, give you more idea about some of the kinds of problems that we've faced and some of the things that we're trying to do about them. Most of you people will recognize Saskatchewan on the first slide. It's not bordered by any kind of an ocean, and its environment is quite a large, long, extended one. There is quite a variety of vegetation areas as you can see from the yellow which is the northern portion of the Great Plains, right up to the tundra through a variety of aspen forest and boreal forest. There's quite a diversity in the kind of habitat we have to operate in in the country.

Saskatchewan has an area of about 250,000 square miles and a population of one million which gives you the impression that there's not much density of population. Unfortunately, though, in the last few years we've been seeing a gradual shifting away from agricultural areas in the province. As a matter of fact, Saskatchewan is losing population. It's the only province in Canada still losing population, and it's because of a shift from rural to urban areas. So we're getting quite a large concentration in the cities, and though you wouldn't think this is true, we are having some urban environmental problems.

The impression most people have of Saskatchewan is as a wide open wheat field area, with a little country elevator and a Chinese restaurant every seven miles up the railway line. More often now as you go through the province you see abandoned farmsteads, as shown on this slide, and a much larger kind of agricultural operation. There are people who are concerned about that and worrying about what it does to the quality of life.

Water is a major problem in the province. Most of our water rises in the mountain regions and flows directly through the province. We only get 13 or 14 inches of precipitation per year in the settled area. So water quality and quantity is a significant problem.

One of the educational programs where we are beginning to see some changes is in getting out of the classroom. There's been a big move in Saskatchewan in the last few years to escape to the real world and get outside. There's a lot of field-tripping going on, the kind of outdoor education that evolved into environmental education. I think we're about at the stage where field-tripping is a major opportunity. You don't need to have an environmental problem to teach students about sampling and make them aware of the natural environment, even though it isn't polluted. Awareness of the environment is a first step in this area and this is what some of the programs that we're getting into are about.

Winter ecology is getting to be a significant program area. This is an interesting kind of approach. There's been quite an exchange of rural and urban students. Students go and spend a week or two in rural areas and go through the kinds of different cultures and different opportunities and different lives that you see. Amazingly enough in Saskatchewan we have lots of students who don't know that their milk and their eggs don't just happen on the grocery shelves, but really are produced somewhere out in the country.

One of the things that our provincial Department of Education is taking some interest in is environmental issues. We have a great deal of information available about Saskatchewan, and so we're trying to utilize particular issues which might be important in Saskatchewan, water quality in the Qu'Appelle Basin, pesticides, mercury pollution, and wetlands management. Through these issues series we're developing a package which is a kind of objective, open-ended case study. It identifies various issues and various actors, puts simulation games and field trip experiences, accompanied by data from our own shop, into a package. Students are spending initially two to three weeks on this kind of operation. They seem to feel it is much more relevant, particularly when they can go out to their own environment to help gather some data as a part of it. Case studies are a good technique to use in the educational programs, and we're finding some success with them.

I would hope that there will be a considerable degree of cooperative effort in environmental education on both sides of our border. I think of the kind of watershed activities that Bob Cook talks about at University of Wisconsin - Green Bay. Watersheds don't mean much according to borders, and I would think that it would be just as useful to have cooperative environmental education programs that would use the northern Great Plains and the provinces of Alberta and Saskatchewan and the states of Montana and North Dakota. I'm not sure this is practical. I'm not sure if it's possible. But I think when you talk about regional environmental education experiences, perhaps the border shouldn't be as important as it might be under political considerations.

Session 11

PHILIPPINE ECOSYSTEMS: ENVIRONMENTAL MANAGEMENT

Estela Llenado Zamora

The term environment has become a favorite word in your country; it seems to be the result of a determined and planned effort of media, educators and lawmakers to inculcate environmental awareness in the public.

A ranch foreman in Oregon told me he could not burn the trimmings from the trees because it would cause air pollution. They must be completely dry, and he must wait and burn this during winter with a permit from the environmental people. On television, weather announcements invariably end up in environmental charts. Newspapers announce pollution alerts, and children talk of ecology in very impressive scientific terms. In the past few weeks that I have been in your country, visiting environmental institutes and universities, and meeting with a number of researchers, scientists, and decision-makers, I somehow had the impression that a highly complex system of environmental management exists in your country, which could only belong to a developed world. Indeed, it would seem that the environmentalists have succeeded in getting the global message of Stockholm to the American citizen, but whether it has elicited the desired response is difficult to assess.

When I received the invitation to speak at the Environmental Symposia Series of EXPO '74, I was made to understand that the order of the day was an overview of the Philippine ecosystems, our efforts at environmental management of our human and natural resources. I came to your country, therefore, armed with an array of academic facts, describing our 7063 islands which nature has gifted with tropical forests, scenic beaches and a wide expanse of blue ocean. For the Philippines, floating like a rosary between the mighty Pacific and the shallow China Sea, has been dubbed the Pearl of the Orient, a melting pot of world culture and races. And for any Filipino, it is most gratifying to trace the origin of his culture through the history of his land, the discovery and the colonization of the islands by Spain, the American era and the Japanese Occupation during the Second World War. The pre-Spanish influence of the Chinese traders and the presence of the Muslims account for the wide spectrum of beliefs, traditions and customs of this Malayan race.

Estela Llenado Zamora is Chairman of the Man and the Biosphere National Committee, UNESCO Philippines, and is a member of the Scientific Committee, Environmental Center of the Philippines.

Our people are born in the midst of agricultural abundance, rich natural resources and an unending summer. The needs of our rural folks are simple. Rice, the staple food, is harvested thrice a year. Fish, shrimps, and oysters, come from the sea, which is fondly called nature's refrigerator. Mangoes, papaya and bananas grow almost everywhere and bear fruit all year round. To provide meat, chickens and pigs are raised in the backyard as well as vegetables. In many cases, there is no electricity. The optimum luxury is a transistor radio.

Not so with our cities. Our cities, just like yours, are teeming with people, attracted by the luxuries of the developed world. The very rich and the very poor crowd in the cities, along with a small percentage of the educated middle-class, whose choice is the 8-hour white-collar job against farming and tilling the soil. For those who do not have the benefit of schooling but still choose to live in the city, there are the shanties, or even the position of housemaids in domestic households. The pace of life is fast, and people move about impatiently, all too aware of competition in their respective worlds, all seeking the "betterment of life" and elusive happiness.

For us, the term environment still remains an academic symbol. We still have to find its exact translation in our native language. We associate it with nature, our green trees, our marine life, our flora and fauna. Indeed, it would be so much easier to conserve than to manage, to forget totally about pollution, waste and poverty.

We are fortunate that we have a leader who has recognized the environmental hazards which accompany development. Even before the Stockholm Conference in 1972, President Ferdinand E. Marcos lent official support to the project of the First Lady, Mrs. Imelda R. Marcos, towards the establishment of the Environmental Center of the Philippines. In support of the objectives of the UN Conference of Human Environment, the Center will serve as a coordinating body for the public and private sectors on projects related to environmental issues.

One of the most rewarding programs for citizen action and public awareness is the cleanliness and beautification campaign conducted through town and city mayors. School participation, particularly of children of elementary age, was encouraged by means of contests on projects on Nutrition and the Green Revolution.

To focus public attention on the ill effects of pollution, an impact project for cleaning the Pasig River was launched by the First Lady on August of last year. Pasig River is the main body of water crossing Manila and discharging into Manila Bay; it is the main artery of water transport and trade, and most of the earlier industrial sites, including the petroleum depots and even the Presidential Palace itself are located on the river banks. It is the equivalent of the Thames, Seine and Rhine of Europe.

During the war, hundreds of war vessels sank or were left stranded on the river banks. Industrial effluents, market and slaughter waste, sewage from shanties lining the river banks, have driven away almost all forms of life from this river. Beds of uncontrolled growth of water lilies blocked the passage of the ill-smelling water and caused overflowing into floods during the heavy rains.

Today, after enormous efforts from the heads of key agencies which formed the core of the Pasig River Development Council, the river has been brought back to life. The vessels were dredged, towed away, and converted into scrap. Embankments and lights have transformed a once dangerous area into promenades, flower marts and tourist stalls. Model duck farms are being made to restore the old custom of balut-making to the town of Pateros. (Balut is a delicacy of the Orient made from incubated duck egg to form a chick and hard-boiled.) Above all, the inputs of the school children to form botanical fences along their respective portions of the river banks have produced replica efforts on the part of the parents who have started planting vegetables and economical plants in their gardens.

The Environmental Center of the Philippines will be housed in a modest building in a project triangle where the Population Center of the Philippines and the Nutrition Center have recently been constructed, all under the chairmanship of the First Lady. Health and agricultural productivity projects, industry incentives for economic well-being, art and cultural presentations are all part of the plan for the upliftment of the quality of life.

Another project of the First Lady is the resettlement of the squatters along the coastline of Manila Bay. She chose a notorious area near the pier and the harbors which were long occupied by shanties and slums. All their lives, these people have lived on this shoreline, making their living from the sea and the port. The Tondo Foreshore Urban Renewal Project is a gigantic project which has gained the support of the World Bank and German Aid. It calls for a planned community, providing for housing and sociological and economic assistance for its people. Cottage industries, family planning, elementary education are but a few of the aspects being introduced into the lives of these people.

The President has formally given top priority to the problem of human settlements by creating the Presidential Task Force on Human Settlements, whose primary concern is to advise the President on planning settlement areas, land use and industrial zoning. Furthermore, the Ministry of Industry has started a strict surveillance of pollutive industries, and environmental permits must be obtained before a new factory can be approved for priority incentives by the Board of Investments.

The top planning body, the National Economic Development Board, has placed the environmental component in its developmental plans, particularly in the management of natural resources. The Pollution Control Commission under the National Science

Development Board is charged with the control of air and water quality in cooperation with the other policing bodies. Suffice it to say, that there is no lack of interest and active support on the part of policy-makers to protect the human environment.

One of these programs which immediately obtained governmental support is an interdisciplinary research framework of the UNESCO, the Man and the Biosphere Programme. The Programme is concerned with the ecological effects of human activities on various ecosystems, such as forests, grasslands, lakes, rivers and coastal zones, mountains and islands. The approach to the programme consists of the description and analysis of the ecosystems, study of the impact of man on his environment and of the environment on man, and the selection of the structural units which can be integrated into an area of study. By application of the simulation techniques, the testing of models of different ecosystems can be done for arriving at strategies for resource management as a basis of action for the decision maker.

The Philippine participation in this programme involved an interesting model for inter-agency cooperation utilizing academic manpower on voluntary consultancy basis. A seed grant from the Ford Foundation enabled the MAB National Committee to undertake an inventory of manpower and research priorities and capabilities in the agencies concerned with environment. To encourage project development, an inter-bureau mobile seminar was initiated and carried out on a monthly basis, with the primary objective of identifying ecological research inputs for resource management. Bureaus responsible for resource management were requested to act as hosts for a series of weekly meetings with agencies which utilize, develop, or harm their resources, and the areas of common courses of action as well as research inputs required were identified. In the final meeting, the public, particularly university researchers and students, are invited to participate in a public forum. The resulting compilation of case papers and the joint resolutions from these meetings form the basis of the planning of the projects to be implemented.

To integrate the interagency effort, a horizontal group of consultants from various disciplines are made available and it is expected that these efforts will culminate in a pilot project to be implemented on the Mindoro Island, which has been set aside by the President as a Biosphere Reserve and formally recognized by the MAB International Council at its last meeting in Washington, D.C. hosted by the USA.

Mindoro is the seventh largest island of the Philippines, and lies south of the western part of Luzon. The area set aside for the MAB reserve for research and instruction is located at the northern tip and has an aggregate area of 23,525 hectares. It covers the town of Puerto Galera in Oriental Mindoro and Abra de Ilog in Occidental Mindoro.

Mindoro represents rather a complex ecosystem of forested areas, grasslands and croplands. Competition among the forms of land use is further complicated by the presence of an endangered animal species unique in Mindoro. Social values and attitudes of Christian settlers towards stewardship of pasture leases and the ancestral rights of the aborigines provide a very interesting social matrix for the ecosystem. The rich natural resources like marble, silica, copper, corals, fish, are rapidly attracting industries. Tourist and recreational areas are rapidly being developed. The reserve provides an ideal microcosm which can be subjected to a total ecosystem analysis for studying rational, optimum modes of utilizing and developing land and natural resources. It also provides a nature center for environmental learning, with the presence of a marine biological station of the State University as well as field stations of the Bureaus of Forestry, Animal Husbandry and Weather Bureau.

While admittedly, the Philippines would be an ideal participant for such studies within an international network, it can not be denied that our national priority is a need for development for economic survival.

Our bubble of happiness is self-contained; it is much smaller than yours since our demands and needs are much less. We can see through it and perhaps feel a little ambitious to attain the modern conveniences which are so common in your world, but yet we must realize the limits of development to allow us to move within the proper dimensions of ecological balance.

Ladies and gentlemen:

In closing, allow me the academic luxury of comparing our environments. It is a rare privilege to be able to share these impressions with such a distinguished group of scholars as this; and I hope to find an echo of response in your ideas.

These past few days, I lived through the motions of an American housewife. First, I did not work, then I became an addict of the television. I discovered frozen convenience foods, and the newspaper advertisements. The dishwasher, the washing machine and the drier saved much of my time, and I needed a car to move about. The amount of dependence on energy was so omnipresent, that I began to appreciate why it takes your President to advise the housewives to use cold water for washing in order to save energy. By the time I have reviewed the department stores and supermarkets which advertise opportunity buys, I had so much wrapping and tags and cartons to throw away that it used up all the time I have saved. These past few days gave me an insight of what you are really up against, of what would happen to our country if time moved forward by two decades and if we continued development towards your peak; it made me wonder, whether the developed worlds are really not trying to move one step downwards from this peak, while we struggle upward, and it makes me close with a proposition on environmental management: That perhaps, the most important and most crucial issue at stake for both your world and mine, the sole thing we have in common, is the conservation of values which are in our people.

DISCUSSION

Willard: Is any work being done on the more sophisticated land disposal of municipal sewage, using land to receive the nutrient material? In the old days it was traditional for the farmers to put night soil on the land.

Bebber: Yes, this is actually a part of our physical planning concept, the planning in Germany. Agriculture in Germany is in the shrinking process, actually the number of enterprises has practically dropped by half in the last ten years. Shortly after the war, about 8.9 million people were in agriculture, and now it's only two million people, which means that those little petty farmers have stopped messing up the landscape--now they do it in a more sophisticated way. We have a strict control on all sorts of surface use.

Willard: To the ecologist, man as a species hasn't quite found his niche yet. We express this in our National Environmental Policy Act, and the demand that that act puts on the United States to harmonize human activities with the activities of the natural environment. When you really get into this, one of the things you discover is that except for organisms living in water, the wastes of organisms are all going back to the land, except for man. There are some very interesting, innovative things and sophisticated things coming to the fore as to how human waste can be treated so it is safe from the health standpoint. Then the many nutrients can be used beneficially for growing of crops which people don't consume directly. That's a long story but I think one which environmental education people ought to focus on a bit because sometimes the solution to the problem means refocusing our awareness and not getting in a trough and staying there. It's very important to have a trough with sloping sides rather than vertical sides, so that it can be open to new, innovative ideas.

Question: What is the federal government in Germany doing in regard to necessary training and education?

Beatrice E. Willard, the moderator for Session 11, is a member of the U.S. Council on Environmental Quality.

Bebber: The training and education of environmentalists is up to the local governments of the states, they have the sovereignty in Germany. In the last few years, the German educational system has changed drastically to a concept that deals more with present-day demands, which means an increasing number of technical colleges and technical universities are found in Germany. Every newly established university automatically has a chair for environmental sciences. There are special universities in Munich, for example,Hanover and Berlin, where they have special chairs for water engineering.

Of course, the output of graduates of the universities is not now matching the demand for engineers and technicians, experts in all fields of the environment. Now we have to do research work on how many engineers and technicians we need, because like in any other country of the Western world, the output of academics in Germany is increasingly high, and it reflects some very strange and peculiar vocational planning in the past. We have an enormous amount of psychologists and sociologists now. We don't want to encourage too many environmentalists in the future.

In my opinion this is actually one part of the environment, having a decent job and a decent profession.

Question: I was wondering what was going on in Canada in programs for educating people not of school age, like community education.

Heal: Through the Canada Water Act we are getting ourselves into a number of water basin studies and proposed developments, hydro-developments. One of the things that's happening in these impact studies is that there is a fairly intense degree of public involvement. Using one specific example, on the Churchill River in Saskatchewan there's been a proposal for a major hydroelectric dam. The government has indicated that before it will make a decision on that dam, they will hold two to three years of studies and have an open information policy about the environmental effects of this kind of thing. The budget allocated 10 percent of the total studies budget to public education activities, and some materials were prepared and distributed to various information centers, workshops and so forth. Probably this is one indication where attention is being focused by the government, it's trying to involve people in particular studies in their area. Now it's not all a bed of roses as you found down here; there are all sorts of issues and unanswered questions. But I think there's a fair degree of commitment in various political circles and governments in Canada that these issues are too complex for decision makers to try to decide all alone. They've got to involve the people early in the planning stage.

RESEARCH NEEDS IN WATER QUALITY CONTROL

Perry McCarty

We regret that the tape recorder malfunctioned in Session 12, and it was not possible to obtain a manuscript of Professor McCarty's paper.

Perry McCarty is Professor of Environmental Engineering and Director of the Water Studies Program, Department of Civil Engineering, Stanford University.

ENVIRONMENTAL ENGINEERING EDUCATION FOR THE FUTURE

Donald J. O'Connor

While it was not possible to obtain a manuscript copy of Professor O'Connor's remarks, here is a summary of them:

Professor O'Connor reflected on the heritage of environmental engineering education. He commented on the various factors that have produced the scientist versus those that have produced the engineer, and biological-life science education versus mathematical-physics education.

These two different orientations have conflicted in environmental engineering education, to produce a difficult but also a challenging situation. For many years, Professor O'Connor has been interested in trying to bridge those gaps, and this was the major subject of his remarks.

Donald J. O'Connor is Professor of Civil Engineering at Manhattan College (The Bronx, New York City). He was formerly President of Hydroscience, a consulting engineering firm, and has been a consultant to industry and government, as well as a member of numerous advisory committees.

EDUCATIONAL RESPONSIBILITIES UNDER THE WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972

Kenneth L. Johnson

I'm going to talk about immediate educational responsibilities under the federal Water Pollution Control Act of 1972. As was mentioned earlier by both speakers, eliminating all effluent discharge by 1985 is sort of pie in the sky. But at the same time, the people were speaking through their representatives (the vote for the act was something like 400 to nothing). What they were saying was, "We've been convinced, especially over the last 10 years, that there are too many effluent materials in our water, and too many pollutants in our air, based on the information we have right at hand. Let's stop putting materials into the water or putting it into our air. Let's do something right now."

And they did that in the law. The two most important titles in my mind are Title III, which is standards and enforcement and Title IV, which is permits and licenses. There the people are saying, "Here, do this right now. Let's at least begin to turn the other way, let's not have unrestricted pollution of our waterways." For example, there is Section 301 in Title III, on effluent standards based on technology mostly available right now, or the standards in Section 302. There is Section 303 asking the states to set up plans to clean up the nation's waterways within the foreseeable future. In Section 306 there is provision for national standards for new sources. Section 307 puts standards on toxic materials and provides for treatment standards for industries that discharge into municipal systems. And Section 311 is doing something about oil spills. Section 316 is doing something about thermal discharges.

I'm going to be talking principally about where we are going to get the people that are going to take care of all these sections, and those who are going to take care of the National Pollutant Discharge Elimination System which was set up by Title IV in Section 402. In the public sector I'll talk about state agencies, about municipal wastewater treatment authorities. For the private sector in industry, food, and resources the language of the law goes something

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like this: there shall be achieved effluent limitations for point sources that will require the application of the best practical control techniques currently available, or in the case of a discharge into a municipal treatment works, will require compliance with pre-treatment requirements.

Those requirements are put into an enforceable manifestation by the National Pollution Discharge Elimination System. But living up to that kind of a standard, that kind of a permit requires all kinds of people as you recognize, people to plan for the industry as to whether by a change in the process, for example, they can minimize their effluent discharge or use of water; people who design essential equipment, people who build control equipment, people who operate it, people who monitor it to make sure it's doing the thing it was planned for; people who monitor and begin to determine what is required. We're talking about more than 20,000 industrial sources across the country and those people from chemists down to technicians have to come from somewhere, and it's the responsibility of our educational institutions to produce those.

Now, where's the money going to come from, to develop or sustain the university courses, community college courses, vocational, educational? I think for the private sector that the Congress, and the people too, expect funds for that kind of education to come from the private sector itself through supply and demand. If they're forced by a permit situation which we've never had before, the permit situation is enforced to the letter of the law, and industry says, "Hey, I'd better take care of this or I'll get a tremendous fine or even put in jail," I think the industry can and will take care of itself. That's perhaps not true of the public sector. For example, for state agencies some of the wording of the law goes like this: each state shall establish for the waters identified the total daily limits for pollutants...Each state shall have a continuing planning process for water pollution control...Any applicant for a federal permit shall provide a certification from the state that any discharge will comply with the applicable provisions of this act."

Now again, the state needs a great variety of trained people; people who are cognizant of the sum total of all discharge into a given segment of a stream. How do you allocate the load among all of them? How do you allocate control among all of them? People who review plans and specifications submitted by people who want to build control equipment and who are then asking for a permit or a construction grant. People who monitor the quality of the water or the effluent or sources of pollution. People who enforce the law, enforce the standards under the permit system.

We have ourselves this summer, in the Environmental Protection Agency, made an assessment as to what the needs of state agencies will be in the reasonably foreseeable future for taking care of this sort of thing. There are five basic categories of work which are required by the Water Pollution Control Act Amendments.

In water quality monitoring, it's expected that about 440 men each year will have to be taken on across the country in new hiring due to the expansion of the state agencies, staffs, and replacements. These are basically chemists, laboratory people. There'll be something less than that, about 340 new people each year, needed for facilities planning. That's for assessing what kind of control is needed on a given stretch of stream for a specific municipality or industry. There will be something less than a hundred people needed for the administration of construction grants principally supplied by the government, something less than 200 people a year needed for helping municipalities operate and maintain their waste treatment plants. When I say "help" I mean to make inspections, provide advice and counsel to the municipalities so they do a good job. And there will be something less than a hundred people a year needed for controlling oil and hazardous materials. I'm talking of professional people now.

If we're talking about technicians, there are approximately the same number of technicians for water quality monitoring as professional people, something around 400. For helping out in operation and maintenance there are about the same number of people as for professionals, about a hundred again. Those are the needs of state agencies.

Now, state agencies of course, can go to their colleges and universities to provide those kinds of people, but I think there's going to have to be some kind of system through the states for making sure that they get educated people, or to provide fellowships. For example, we're thinking of ways of setting aside a certain amount of the state program grant money specifically for manpower development and training for state agency use. There's also a possibility that there will be some states undertaking to a greater degree a fee system, in which if somebody comes for review of a construction grant application or a permit they will charge a fee to the municipality. The municipality will be able to claim that as an eligible project cost on a construction grant program. Again, that might perhaps be useful for educating state agency staffs.

But the biggest need right now, the immediate need for training people, is at the municipal waste treatment level. We've made an assessment this summer that we have about 70,000 people working as operators and maintenance personnel in municipal waste treatment plants across the country. That information was provided to us by the states. And the states also collectively indicated that that was less than what was recommended for doing a good job right now. Something like 15,000 more people are needed to do a good job right now. You might think that that's self-serving. They're simply saying that they need more people just as everybody needs more people to do the job.

But we have independent information to support that. We, as a matter of fact, each year, because it's required by law, have to make an assessment of wastewater treatment plants built with our funds, and each year all the inspections of those plants that were conducted during the last year are looked at. It was found last year, for example, that 30 percent of the plants that were built with our funds were not being operated and maintained so they would meet design standards. In part that may be due to poor design, but in greatest part it's because there simply aren't enough trained people in the plant to do the job. Each year we're spending literally billions of dollars to build these treatment plants. If we talk about 30 percent we're talking about several hundred millions of dollars of your money and my money, taxpayers' money, which is being wasted.

So, the greatest shortfall of people is to be educated and trained, the greatest need we have right now is for municipal wastewater plants. The estimate is that there'll be about 10,000 new hires needed each year, and we'll have to upgrade about 40,000 each year. We also found this summer that there's a tremendous turnover. You know, working in a sewage treatment plant is not thought of as being the greatest job in the world. People get low salaries, they have no status whatever. The first chance they have to go somewhere else, they do. We have to make sure we do something about training and keeping people in our municipal plants or we're never going to achieve any of even the realizable goals of the act. It's something we have to do right now.

I want to read you some conclusions that I wrote up six weeks ago with regard to what the federal government can and should do about educating people to achieve as much as is possible. Conclusion number one was that state and local institutions must provide the bulk of the manpower training required to effectively implement Public Law 92-500. EPA's national training center will only be able to train a small fraction of the personnel required.

The number of people we train here actually is only 10 percent of the number. We cannot do much more with the resources we have.

Conclusion number two: with current resources EPA can develop and distribute for state and local delivery training course materials covering major federal requirements for implementing the act. We can provide traning course manuals and videotape instruction material. We can provide that for wide dissemination, but we can't do all the disseminating ourselves.

Conclusion number three: with current resources the EPA can support with funding and course materials projects for improved operation and maintenance of public waste treatment facilities. But the states and local governments must undertake the responsibility for this type of training. We can go out, as we are right now, with grants,especially to community colleges and other schools for demonstration courses on how to train operators of treatment plants.

Conclusion number four, and this is perhaps of direct importance to you here: with current professional training grants, EPA cannot guarantee an adequate supply of engineers, chemists, etc. to implement Public Law 92-500. With the funds we have available we can't do it entirely. The National Pollution Discharge Elimination System permits, if strongly enforced, may provide enough incentive to effectively develop a satisfactory approach. EPA should closely monitor the supply of professional people available for implementation of the act. If it appears that additional federal support is required, the agency should work to obtain this additional support. And that's our responsibility.

Conclusion number five: it can be expected that state and local governments will not immediately have the capability of undertaking all of the direct training required for effective implementation of the law. EPA should closely monitor the performance of state and local governments in manpower development. Where training needs are critical and inadequate state and local performance jeopardize the act's implementation, EPA should provide direct training. States should be encouraged by financial incentives to develop and maintain strong manpower planning and development programs to minimize the necessity for federal involvement in direct training.

As a result of these conclusions we've established an EPA manpower development and training strategy to build up a list of actions we will take over the next two years to try to make what's needed happen.

In closing, I'd like to look ahead a little bit. I think that we'll have to change our ideas about water pollution control in the traditional sense, treatment and discharge. We have to prepare an assessment of needs for municipalities, new capital construction to meet the requirements of the act. And this year we did it, and included within the normal treatment plans major septic sewers and the like; we also included how much it was going to cost to treat or do something about combined sewer systems and storm water in order to meet water quality standards. This year's assessment was that the cost of all this would be $350 billion. The Office of Management and Budget likes to say to us, ".35 trillion dollars" because they want to accentuate the amount that we're talking about, and it's hurting. We're talking about $350 billion, we're thinking, "Gee whiz, we're really getting into the big leagues. We're getting close to the Defense Department."

So we really have to concentrate on research not only about treatment and taking out heavy metal from wastewater, but research on preventing the pollutants from getting there in the first place. If, as in New York City, we're getting a lot of heavy metals in the water from street washings -- lead, for example, from leaded gasolines -- we have to develop means for not getting them there in the first place, rather than trying to treat them after the fact. We'll have to talk about recycling to a much greater degree.

We can do a lot of things right now, in the immediate future, to clean up our nation's waterways. But looking ahead to the more distant future, we can't just be the traditional sanitary engineers. We have to think not only about treating wastewater, but about looking at a whole system of preventing the pollutant materials from getting into the wastewater in the first place.

DISCUSSION

Question: I wonder if you could say something about the kinds of training programs that you envision.

Johnson: If we're talking about people working in a municipal plant, we're actually talking about upgrading people that have maybe a high school education at best. I think the average municipal employee has a 9th grade education. What we would be doing there basically is teaching the practical principles of wastewater treatment plant operation, plus the basic principles of sampling the wastewater. We have within recent days sent out to each state agency a student reference manual, which is a guide to teaching treatment plant employees the basic tests for federal permits in very cookbook fashion. If you can follow this, you can do the basic tests. That's the kind of thing we're talking about for municipal plant employees.

We're talking about people in state agencies. I think here we're talking about depending by and large on traditional sanitary engineering, traditional chemistry courses for professional people. The kind of program that we're going to now would be that a fellowship would be made available to the man and he would be encouraged to go back to the university. We're also talking about having in the future -- this is strictly preliminary -- perhaps a cooperative work-study program with state agencies.

We do have something like $340,000 this year for undergraduate grants, and $2,700,000 total for professional training grants. We have grants now for the development of curricula in colleges and universities and especially in community colleges. We principally can help state agencies and municipal waste treatment authorities. As I indicated earlier we do not have enough money, enough financial resources available right now to guarantee an adequate supply of professionals to implement PL 92-500.

Question: I asked because one of the fields I'm in is elementary and secondary education, and I would be very interested in knowing that here's a field

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Robert F. Ruhl, Assistant Chief of the Academic Training Section of the U.S. Environmental Protection Agency, moderated Session 12.

with a crying need for several hundred thousand employees.

Johnson: Well, it's not several hundred thousand employees, at least in the municipal area. You can have one community college within a state specialize in, say, wastewater plant personnel. But the state couldn't have very many vocational high schools with a wastewater treatment plant course and have enough people as potential students. Maybe I'm wrong there; maybe other people have different ideas. That's the hardest thing to sell to the people across the country, that for a given community there aren't so many.

Comment: I would like to make a comment about the public expecting industry to take care of itself (and I've been guaranteed that they will) -- that's what concerns me most, the manpower needs. While you're trying to upgrade the state and local wastewater treatment facilities, you're always going to have industry hiring away the people that are being trained. A man becomes reasonably good; then industry's going to take him. The same thing has happened with professional personnel. That's one of the big problems right now.

Johnson: That's why we'd like to focus on using our grants in the future as fellowships for state agency employees, for example...

Comment: And insist that they stay with the state for awhile. That's the only way you're going to keep them, because once they stay with the state for two or three years and become very valuable to industry, they get hired away anyway.

Johnson: There were 900 people trained on our professional grants, and half went to private industry.

Question: I have to bring up a certain note of caution on how you administer funds to state agencies for the purpose of training. It has been our experience at least in our state that not necessarily will the individual that best deserves that type of support get it. People work in state agencies many times only because nobody else wants them. You end up with a student that really can't cut it, and it's a gross misuse of the funds. Therefore, I'd have to vote against this way of doing things and this training. I'm not so sure that the universities shouldn't have a better handle on the selection of fellowship recipients than the state agency.

Question: One thing that's been giving me considerable concern are some of the disincentives which are contained in this act. We as practitioners out in the field are required to consider new technology, and yet the very rigidness of the act itself prevents, in many cases, a new technology from being tested in the field. It's very difficult to persuade somebody out there to spend a couple of million dollars on a project which, in effect, is not proven. And if they install such a project, and the project does not come quite up to expectations, then technically they're in violation of the provisions of this act. People are becoming scared to try anything.

Answer: When the construction grant regulations were filed about a year ago there was a recognition of this. One of the sections of the final regulations that didn't appear in the draft was written specifically to encourage the use of new ideas. Under the old regulations, the only projects that could be built with construction grant funds were projects that had been demonstrated. That was rejected in the final regulations and I think they say that pilot - scale tests would be sufficient. This was meant to encourage innovations in this field.

Comment: I'd say that demonstration is certainly where a lot of the research and development funds of EPA are going now. I agree that that's needed, certain for our new processes. They have to be demonstrated someplace and it's probably the responsibility of the federal government in conjunction with whoever may get the benefit from it to demonstrate the facility. This probably doesn't fit too well within the scope of the university kind of research, a demonstration plan, but it is certainly a necessary kind of research.

Comment: The problem is, of course, the gap between the manufacturer who's doing equipment development and the original basic work which is done in the university. Somebody has to pick up the work from the university and carry it from there. A lot of this new technology is just dropping into the swamp because there's not really enough incentive for it to really be developed. Everybody seems to be content with the way we've done it in the past. Nobody wants to try anything new.

Comment: The point I'd like to make is that, early in the support of professional engineering education we derived our funds from research which reinforced the university objective of developing new knowledge. Then about 10 years ago, you shifted to the support of terminal master's type of people with an elimination of a lot of support in the research grant area. This has turned out a lot of people. But it has also degraded the research effort of any university. As you tend to shift the responsibility for training the terminal people back to the states, which I think you can do in the long run but not instantaneously, then the university contribution to a large degree will be working on problems that we don't now have. That means that we will have to go back to develop centers of excellence in certain research areas. What you can't expect is that the states are going to support the type of research program that is going to create the centers of excellence that will be needed in the future.

Session 13

THE ENVIRONMENTAL SCIENCES PROGRAM AT TEXAS CHRISTIAN UNIVERSITY

Leo Newland

The title of this session is "Some Different Approaches at the College and Graduate Level" and it is felt at Texas Christian University that we have accomplished a somewhat different approach to environmental education. Currently, the environmental education program at T.C.U. consists of two separate and distinct parts; an undergraduate curriculum which leads to a Bachelor of Science degree and a graduate curriculum terminating in a Master of Science Degree. Both of these degrees are titled "Environmental Science" and include students with quite diverse backgrounds, but an interest in developing the knowledge and skills needed to maintain and improve the quality of our environment.

Upon initiation of discussions concerning what our program should consist of, it was decided that since there was not an engineering school and since there was not a strong sociological foundation at T.C.U., but that there were some exceptionally strong science departments already present, we would be best equipped to base our Environmental Sciences program on science. Furthermore upon investigation of existing environmental programs at that time (1968), it was discovered that most were engineering-oriented with many good programs already in existence. It was with all of these considerations in mind that it was decided that both our undergraduate and our graduate programs would be based on a strong science foundation.

For our undergraduate Bachelor of Science degree, T.C.U. requires 132 semester hours or credits. Of this, 50% (or 66 credits) are taken in hard sciences courses (Figure 1). Please note the distribution of credits taken in biology, geology and chemistry. We feel that a scientific understanding of environmental problems will only come after the student has accomplished the basic fundamentals of biology, geology and chemistry. These are the tools of the environmental scientist and are essential. One-half of the biology and geology courses are pre-determined while the remaining 50% may be chosen from a lengthy list of biology and geology courses. The required biology courses include a year of life

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SCIENCE COURSES

- Biology - 18 semester hours
  - 9 semester hrs. - Biology core (Life Science and Ecology)
  - 9 semester hrs. - Biology electives
- Geology - 18 semester hours
  - 9 semester hrs. - Geology core (Physical and Environmental mineralogy)
  - 9 semester hrs. - Geology electives
- Chemistry - 16 semester hours
  - 10 semester hrs. - Chemistry core (Inorganic and Quantitative Analysis)
  - 6 semester hrs. - Chemistry electives
- Physics - 8 semester hours
- Mathematics - 6 semester hours
  - 3 semester hrs. - Math core (Calculus)
  - 3 semester hrs. - Math elective (Computer Science)

Total 66 semester hours of sciences

SUGGESTED ELECTIVES

Urban Society
Urban Design
Municipal Government
Public Administration
Systems Dynamics
Physical Geography

UNIVERSITY CORE

12 semester hours, Humanities
12 semester hours, Social Sciences
12 semester hours, Sciences
14 semester hours, Miscellaneous

FIGURE 1

Bachelor of Science Degree in Environmental Sciences

sciences and ecology at the sophomore level. Examples of the biology elective include botany, aquatic biology, comparative invertebrate zoology, limnology, and marine ecology. The required geology courses include physical geology, an introductory level course in environmental sciences, and environmental mineralogy. Electives may be chosen. Such courses as meteorology, oceanography, geology of natural resources, marine geology, and environmental geology. Required chemistry courses include a year of general inorganic chemistry plus quantitative analysis. We suggest to the student that he take one semester each of organic and physical chemistry to round the other chemistry requirements. In addition to these biology, geology, and chemistry courses, the environmental sciences major must take a year of physics and a year of mathematics including calculus.

In the second half of Figure 1 are listed the suggested electives for the program as well as the University Core. Our University Core added to the required science courses totals 104 semester hours leaving 28 credits which may be chosen from the "suggested electives." Our University Core states that a student must take 12 credits in the humanities, social sciences, and sciences. It does not state specifically which courses; therefore, there is a tremendous amount of flexibility enabling the student to essentially write his own curriculum within certain guidelines.

Due to the obvious difficulty of this curriculum, it requires a student of at least average intelligence or above to complete the program. In actual fact only the better students elect to enter this program. In actual fact only the better students elect to enter this program. The average SAT score of the students in the undergraduate Environmental Sciences Program at T.C.U. is some 200 points higher than the average entering at T.C.U. or most other schools. Because of this very high caliber of student in the program, we utilize them extensively in our research program. We have published many papers with undergraduates as co-authors. This is a rare opportunity for an undergraduate at most schools.

This brings us to the graduate program which leads to a Master of Science in Environmental Sciences. Our master's program is designed principally for students with scientific training or background, but students with other undergraduate degrees have successfully completed the program. In fact we have had individuals who have come to us with degrees in such far away disciplines as history and French. Naturally, these individuals have a considerable amount of undergraduate prerequisites to make up - but if they are truly interested in environmental sciences, they will make the effort. The undergraduate prerequisites that we require are 1 year of biology and chemistry, 1 semester of physical geology and calculus, and 1, of course, in regional planning.

If one analyzes the curriculum for the master's program (Figure 2), it breaks down into 4 categories: core requirements, seminar, electives and thesis. The

CORE REQUIREMENTS	
Aquatic Biology (theory)	12 semester hours
Field Techniques in Environmental Biology (Application)	
Geochemistry of Natural Waters (Theory)	
Instrumental Analysis (Application)	
SEMINAR	3 semester hours
Environmental Sciences	
ELECTIVES	9 semester hours
Biology, Geology, Political Science, Sociology, Economics, Public Administration, etc.	
THESIS	6 semester hours

TOTAL - 30 Semester Hours

FIGURE 2
Master of Science Degree in Environmental Sciences

core requirements are composed of 2 courses in biology and 2 courses in geology. The two biology courses have one theory and one application course as do the geology courses. It is felt that this combination of theory and applied courses helps make a well-rounded master's program. First, one learns the theory and then the applied aspects to implement those theories. It should be pointed out that while our undergraduate program is quite broad in scope to cover most of the areas of environmental science, the master's program is limited principally to the aquatic and terrestrial environments. Most of our courses are oriented toward aquatic sciences. Most of this limitation is due to lack of personnel and resources to conduct research in the other fields of environmental sciences.

To complete the requirements for the master's program, we require 3 seminars, 9 semester hours of electives, and a thesis. The thesis may be written in any aspect of environmental sciences that the student can find a major professor to direct. Past theses have been written on many subjects including bioassay techniques, trace metals, pesticides, economics of resources, nutrient uptake, etc.

This completes the current degree programs at T.C.U. and brings us to a discussion of our proposed new degree. We are proposing a D.E.S. degree, a Doctorate of Environmental Sciences. This is not a Ph.D. degree, but is an entirely new concept which involves three facets: formal course work, research, and on-the-job training. It is application oriented and designed to train students to solve the diverse problems of the environment by making them aware of the multidisciplinary approach needed to do this satisfactorily. To train such professionals, an instructional sequence has been selected from a broad spectrum of disciplines to support independent investigation and the acquisition of practical experience in a selected field of environmental science.

Such a curriculum is not aimed at the traditional approach of training in-depth researchers or theoretical academicians, as is traditional with most Ph.D. programs. On the contrary, it is designed to train imaginative professionals well acquainted with the interdisciplinary problems of the environment and well qualified to approach their solution in a multidisciplinary manner, be they newly graduated students who have not yet had on-the-job training or experienced individuals who wish to be re-educated and trained for new and more productive careers. Not only will theoretical knowledge be combined with practical experience, but graduates of this program will learn to use all the problem-solving capacities of a multidisciplinary team in dealing with problems. The multidisciplinary team approach has already proven successful at Texas Christian University as evidenced by many cooperative research projects already completed or underway in connection with the Master's degree program in Environmental Science. Faculty members in different departments, and sometimes quite diverse areas, have gone beyond traditional boundaries to provide a team approach to solving environmental problems that lie at the interface of science and society.

The "Doctor of Environmental Science Degree Program" is designed to lead to the degree of Doctor of Environmental Science. It is envisioned as an advanced degree beyond the Master's degree level and thus requires several years of involvement allowing students who become deeply engaged with their work to pursue their interest for more than a few semesters and preferably for more than two years. It transcends a number of disciplines and permits a broad scope of training to meet the diversification of environmental problems. This applied problem-oriented curriculum would not only allow the significant involvement of several disciplines from various departments of the institution an opportunity for cooperative in-class learning experiences but it will, through close association and collaboration with industrial firms and government agencies permit the student to become involved in solving real world problems. This industry/university approach to education will not only save much time and effort in re-educating the college-trained employee but it will facilitate the retraining of experienced individuals for more productive careers.

As visualized, the program will consist of (1) an early period of formal course work followed by (2) project-oriented studies involving faculty members and finally (3) an internship in which on-the-job training will be received with a company or governmental agency. The formal course sequence (see Figure 3) will provide the student with the basic scientific competence to solve environmental problems; thus the requirements will vary with the individual student and will be tailored to his interests and needs. For example, a student interested in public administration or regulatory aspects of the environment might take elective courses in the social sciences whereas the science-oriented student, although he might elect to take science courses, will be advised to intersperse social science, particularly humanities courses thus avoiding intellectual isolation.

Specific required courses will be held to a minimum but the students should have a basic understanding of the elements of the environment; therefore, they should show competence in its biological and geological aspects. Hence, six hours of advanced work is required in each of these fields. In order that students be able to appreciate solutions to environmental problems they should be familiar with the tools of science, chemistry, physics and mathematics; therefore, four courses of undergraduate chemistry, one course in calculus and two courses in general physics are required as undergraduate prerequisites.

In addition to the required courses the student can select 18 hours of elective credit from one or more of the following fields, biology, business administration, chemistry, economics, geography, geology, government, philosophy, public administration or sociology. The selection of these elective fields will be determined in accordance with the needs of the student's specialty under the careful guidance and counsel of a graduate committee headed by a chairman or advisor.

It is intended that this degree program will require the equivalent of 42 semester hours of graduate study beyond the Master's degree, or its equivalent. Each student's program will be crafted to his individual requirements and especially to his capabilities and interests in a particular field. Therefore, no semester by semester plan can be given but our course outline is presented only as a guide.

In addition to the selected curriculum of problem-oriented graduate courses, seminars and cooperative multidisciplinary projects in which, for example, course work in systems dynamics may be integrated with a problem-solving project in an

CORE REQUIREMENTS	12 semester hours

Geology
  Water Pollution Control
  Environmental Geology

Biology
  Advanced Ecology
  Biology of Water Pollution

ELECTIVES	18 semester hours

Geology
  Ecology of Soils
  Sedimentation
  Hydrology
  Marine Geology

Biology
  Marine Ecology
  Invertebrate Morphology and Physiology
  Microbial Ecology I and II

OTHER FIELDS

Systems Dynamics
Biochemistry
Advanced Inorganic Chemistry
Resources
Economics of Urban Areas
Elements of Urban Design
Population Analysis
Environmental Policy and Management

INTERNSHIP	6 semester hours
THESIS	6 semester hours

TOTAL - 42 Semester Hours

FIGURE 3

Doctorate of Environmental Sciences
(Proposed D.E.S. Degree)

environmental science course, the student must serve an internship. This internship is visualized as obtaining practical experience in the area of environmentally-related problems in full-time employment with a company or with one of the appropriate governmental agencies (local, state or federal) for a period of 9 months, or for an equivalent time.

A thesis or dissertation as is required for the usual Ph.D. degree will not be required but a comprehensive report on some aspect of the student's internship will be required. This report will be an important and integral part of the program and will be written as well as presented orally before the student's graduate committee and invited faculty.

This new program is intended to encourage a synthesis of theoretical knowledge, practical experience, and professional intuition culminating in a doctoral degree which is in accordance with the actual demands of modern science, technology, society and industry.

ENVIRONMENTAL STUDIES AT STONY BROOK

Andrew Collver

The Interdisciplinary Program in Environmental Studies at the State University of New York at Stony Brook began in 1971. Now in its fourth year, it has about seventy majors. The program is largely a coordinating one rather than an autonomous series of courses, but it does have four semesters of core courses that give it some integrity. For the most part, the courses that count toward the major are taught by the various disciplines as departmental courses (e.g., Economic Problems of the Environment in economics and the Surrounding World in philosophy). The core courses are taught by the program chairman and a graduate teaching assistant, and by the students themselves. Plans to engage additional faculty in the core program have been delayed for budgetary reasons. Students in the program are required to take four courses from a list of natural science courses, four in Social Sciences, and two in mathematics, besides the four interdisciplinary courses. In addition, each student must develop some degree of expertise in a specialty, with the approval of faculty advisors. The most popular way to complete the specialty is to fulfill the requirements for the major in one of the disciplines, or to take most of one's specialty in one department. The other way is to form the specialty by combining courses in different departments. Any set of courses that can be shown to add up to the development of a marketable skill in the environmental field is acceptable.

The Stony Brook program differs from most in that its chairman is a sociologist. The choice of a social scientist for this role was not by accident, for we begin from the premise that the trouble with the environment is man. That being the case, one does not learn to understand environmental problems or discover possible solutions merely by studying the environment. Seeing that the rapid deterioration in environmental quality is the result of human use of the environment, attention must be turned to human behavior itself, not as a

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postscript to the end of each textbook chapter or lecture, and not as a short final section of the course, but as the topic of primary interest and concern.

This is not the way I would have rationalized my role as chairman five years ago when we were first designing the program. At that time I was willing to accept the leadership position just to keep the program from falling into the hands of a natural scientist or engineer. A scientist would probably tend to think of himself as an expert on the environment and accordingly be relatively closed-minded in his approach and fail to see the need for help from other disciplines. A sociologist obviously could lay no claim to expertise on the environment and would have to seek help from the experts. Not being attached to any of the environmental disciplines, he would be in a position to consult them all without bias.

The notion that the program must be primarily focused on human behavior and institutions and only secondarily on the environment only gradually evolved with experience. Probably the most important influences pushing the program in this direction were the strong inclination of students toward the natural sciences, and the overall domination of the Stony Brook campus by the natural sciences and engineering. If the environmental studies program is to justify its existence, it must offer a real alternative for students. Thus the program came more and more to focus not on scientific knowledge as such, but on the uses of this knowledge.

THE ENVIRONMENTAL MANAGEMENT CYCLE

Any field of study that is to be more than an encyclopedic collection of miscellany has to have some criteria of what is or is not relevant to the field and it has to have some principles for organizing knowledge in the field. After attempting many different approaches, I have finally hit upon a scheme that not only satisfies me but so far seems to make sense to students. It is a simple cyclical chart for presenting an analytical history of the way an environmental problem developed, how people attempted to organize a movement to solve the problem, and consequences that flowed from their efforts.

The procedure that I am now developing is one of learning about environmental policy through case studies. This has a number of advantages. For one, students find it easier to grasp the concrete story of one environmental issue than to try to cope with broad generalizations. The inductive method of teaching is effective with young people who have had few if any experiences with real-life environmental problem solving. Generalizations are convenient for summing up the lessons gained from experience. To the teacher they are a form of shorthand that enables him to cover a large store of information quickly. To the student, however, they are more likely to appear as a form of dogma. What I propose as the teaching technique for undergraduates is the inductive method of examining many cases and trying to see what lessons can be learned from them.

The scheme for analyzing cases is a chart that I call "The Environmental Management Cycle." It is a continuous circle that I have arbitrarily broken into six segments. One segment is the lower half of the circle, which could be broken down into more detail but for the present purposes is left as a "black box." It represents the state of the environment. The upper half represents human behavior, or the social system (Figure 1).

Human use of the environment is the point at which the social system impinges on the environment. The impact of human use has immediate, secondary and tertiary effects ramifying through the environment in a variety of ways and resulting in changes in the environment that have an impact on people. For some, these changes can be evaluated as a net benefit; for others a net loss. Presumably the person who uses the environment in a certain way does so in anticipation of a net gain--but he may be mistaken. Others, as a side effect, may gain or suffer losses, depending upon how they are related to the environmental conditions affected by the human use in question. If one party persists in a use because it brings him a net gain or profit while others continue to suffer a loss, then those others may begin to see the situation as an environmental problem.

Those who are using the environment presumably do so for some reason--there are some incentives for what they do. For the most part, such incentives are not natural or inherent in human nature or the basic requirements of a social system. They are institutional artifacts created by man and capable of being changed by man. For example, the pursuit of profit is frequently seen as a motive for use of the environment. But profitability depends on several factors: the cost of raw materials, capital and labor, taxes, licenses and permits, to mention a few, weighed against the selling price of the product. The selling price in turn depends on effects of freight rates, sales taxes, protective tariffs, presence or absence of government price controls and so on. Most if not all of these factors are subject to manipulation by a variety of regulatory institutions, and they can be readjusted to make it economically unprofitable to use resources in a way that is socially harmful.

On the chart, the institutions that determine the incentive system--taxes, laws, land values, price of labor, etc. are designated as the "environmental management system." This system is seen as managing the environment indirectly by manipulating incentives and then influencing human use of the environment.

The management institutions in turn are social artifacts and they too can be modified or reformed. The state of these institutions at a given point in time is the outcome of a long history of efforts by various interest groups to shape

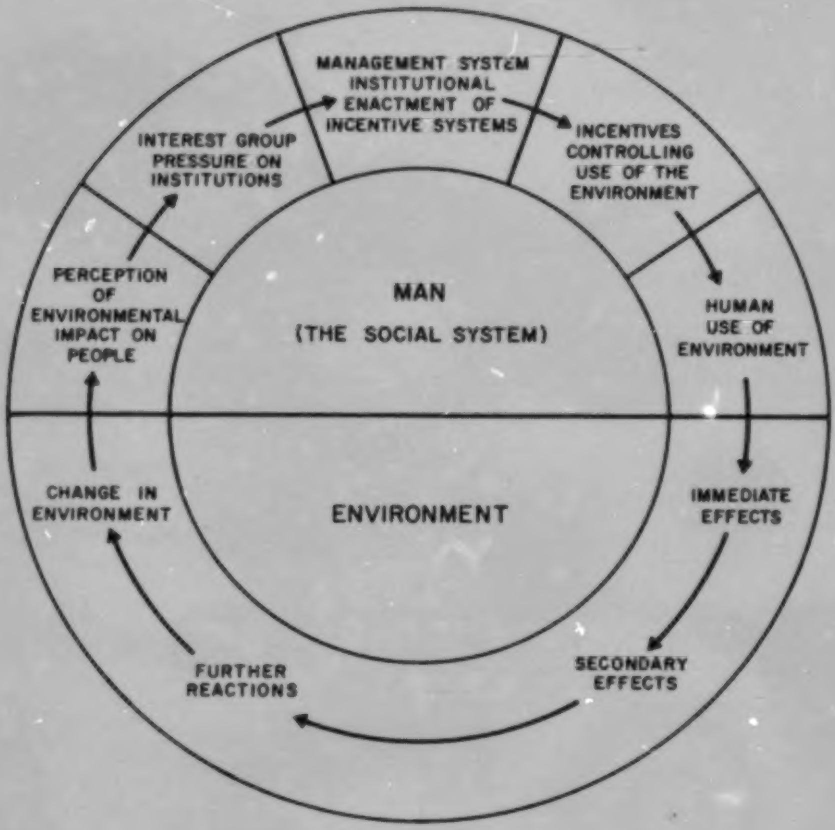
MANAGEMENT SYSTEM INSTITUTIONAL ENACTMENT OF INCENTIVE SYSTEMS
INTEREST GROUP PRESSURE ON INSTITUTIONS
INCENTIVES CONTROLLING USE OF THE ENVIRONMENT
PERCEPTION OF ENVIRONMENTAL IMPACT ON PEOPLE
MAN
(THE SOCIAL SYSTEM)
HUMAN USE OF ENVIRONMENT
CHANGE IN ENVIRONMENT
ENVIRONMENT
IMMEDIATE EFFECTS
FURTHER REACTIONS
SECONDARY EFFECTS

Figure I

The Environmental Management Cycle

institutions for their own benefit. Exploiters of natural resources for private profit to the detriment of society at large ordinarily can be expected to use some portion of their profits to influence the management system. Others, who bear the social costs, are usually scattered unorganized individuals. If enough of them are hurt badly enough and long enough, however, they may begin to organize a reform movement to attempt to influence the management system.

The cycle can be used to trace the history of development of a problem, or it may be used as a guide in the anticipation of the environmental impact of proposed actions. For our purposes in the environmental studies program, we use it as a way of organizing our thoughts about the history and outcome of environmental issues, the contest between different interest groups and the choices of tactics for influence on each side of the issue.

After examining several cases in this framework, we hope to be able to say some things in general about the formation of environmental management policies. Right from the beginning the chart tells us where to look for solutions and and alternatives. The causal chain leads back to the individual in the environmental reform movement: the trouble with the environment is man; the trouble with man is the incentive system; the trouble with the incentive system is that it comes from an obsolete and inadequate management system; the trouble with the management system is that it has not received vigorous enough pressure on behalf of environmental protection and the public interest. If people want to protect themselves from the adverse impacts of resource use, they must seek reforms in the management system.

OBJECTIVES OF THE PROGRAM

We have a set of admittedly ambitious goals for graduates from the Environmental Studies Program. It would hardly be worth the effort to try to develop the program for the sake of more modest goals.

1. Graduates should be sensitive to environmental impacts not only upon themselves today. They should also be sensitive to possible future impacts and to potential or present impacts upon others less fortunate than themselves.
2. They should be able to analyze an environmental problem situation in terms of the environmental management cycle, taking into account the total situation, environmental and social.

3. They should be inclined to direct their reform efforts through the management institutions and not be satisfied with personal direct action to clean up the environment. Thus for instance, we would expect our graduates not to stop at picking up litter or recycling their own beverage containers but to press for a ban on one-way bottles and cans.

4. They should have the initiative to be change agents and not simply fillers of predetermined career positions. To a large degree, they must be prepared to create their own jobs.

5. Finally, we would like to be able to steer our graduates toward opportunities in which to carry out their aims by helping them to find jobs in which innovations are possible.

Against those high aspirations we must contrast the character of the material we have to work with. In the few years of working with students in the program, I have found that they mean well but that many of them have some quite discouraging attributes.

1. Their idea of education is a process by which they are given specialized compartmentalized information and told to study and remember it long enough to pass an examination on it.

2. They are accustomed to receiving education passively and not actively pursuing it wherever it may lead. They presume that it is the teacher's responsibility to find information and hand it over to the students.

3. Among students there is a prevailing sense of unreality and disbelief. Education is a game they play to please adults and receive rewards. The school is a make-believe world, and they have been institutionalized in this world for so long that they are not at all confident that they will be able to cope with the real world. As children they saw on television a continuous flow of fact and fantasy all run together and were given no criteria by which to select the true from the false. The safest thing is to doubt it all. The result is an overwhelming illusion of ignorance.

5. In this frame of mind it naturally follows that most students doubt that they can act effectively in the real world. When asked to work on a problem, they respond with such excuses as "What can I do? Everything has been done already." or "Better minds than mine, with time and financial resources have tackled the problem and failed, so there's no use in my trying." The prospect of turning these young people into dynamic change agents appears dim indeed. How can it be done?

In the program we try to give students several kinds of experience that will break them out of the patterns of thoughtless memorization and passivity instilled in them by the educational system.

1. One thing that must be done to free the mind to think about problem solving is to break down the mental barriers between disciplines. By working in interdisciplinary courses and on interdisciplinary team projects, the student begins to feel more at ease in pursuing a problem even when it leads him across disciplinary boundaries.
2. Another thing we stress is individual and group initiative. Time after time, students are asked to define their own problems and go out and find whatever information is needed to solve them. Still, they often find it hard to believe that what they are doing is not just another prerehearsed laboratory exercise for which the teacher already has the answers.
3. The sense of unreality is attacked by the principle of life-involvement. Students are asked to involve their hands, their whole bodies as well as their minds in projects just to discover that by taking action they can have an impact.
4. Probably the one most effective device for turning students into real people doing real things is to put them in a situation where they can work with someone in the community. They are very hesitant to go out and initiate contacts themselves, but once introduced to people, they can become very excited and enthusiastic about their work. This aspect of the program has not been developed well, for it would probably require a substantial devotion of staff time to community relations. To fulfill its aims, environmental studies must become community based.
5. Finally, in order to overcome students' own feelings of powerlessness, we seek to give them the taste of success in small things. Even at the risk of becoming trivial or making ourselves the laughing stock of the campus, we encourage students to first try their hand at simple things: Plant some flowers or shrubs, recycle newspapers in the dormitory. In doing these things, they have immediate success, but they also discover that these actions are not as simple as they seem. They may encounter administrative obstacles and obtain some elementary lessons in the different phases of the environmental management cycle. They may plant a tree, but when the grounds crewmen mow it down a few days later, they learn that if the tree is to thrive there must be some changes in the management system of the campus grounds. When a student who started a recycling project graduates or moves to another dorm, or becomes too busy with something else, the project dies. To be really effective it has to be institutionalized for continuity.

PROGRAM COMPONENTS

The core of the program is the senior project. It is the culminating effort to bring students together for interdisciplinary teamwork on regional problems. A prototype of these projects was completed the year before the program started. It was a student-originated study of Mt. Sinai Harbor about ten miles east of the campus. Supported by a grant from the National Science Foundation, twelve students worked in the field during the summer of 1971. They looked at the history of dredging in the harbor, the impact of dredging on the environment, the regulatory agencies responsible for dredging and the attempts at reform of the regulatory system. They showed that although the harbor is under much stricter protection than before, there is still the possibility for destructive exploitation to occur. The report, "Political Ecology of the Wetlands" was mimeographed and circulated to interested people in the area.

Subsequent projects have focused on pollution of the Great South Bay; the multiple problems of Port Jefferson Harbor with its conflicts between recreational and commercial and industrial uses; schemes to save the farms of Suffolk County; management of the underground water supply of Long Island; offshore oil drilling along the Atlantic Coast; and environmental education for the elementary schools. This year we are doing a series of case studies of coastal zone management, with cases illustrating management of wetlands, water quality, erosion, wildlife and scenic values.

In order to give students a greater sense of the importance of the senior project, they are provided with some desks and a file cabinet and bookshelf in the program office. They are treated as research associates would be treated on any research project.

A special library, The Environmental Information Service, has been created in the main library in connection with the documents department. It was started with a Ford Foundation grant in 1970 and has been taken over as a permanent feature of the library. In it we collect files of information on the region--publications of local planning agencies, newspaper clippings, proceedings of conferences, scientific research reports, student term papers, studies by the League of Women Voters and so on. Most of these materials would not otherwise have been collected by the library. Previously, such information was extremely hard to obtain. Now it is available for convenient public access. Students who use the files are asked to contribute new materials that they discover in their research and to contribute their reports when finished. In so doing they know that they are not just performing an exercise for a grade but that they are contributing to the growing body of information about the region.

The environmental studies program has to have some kind of applied or action component. To expect to turn out effective environmentalists without giving them any experience in environmental action would be like turning loose a batch of book-trained farmers who had never plowed a field or planted a row of corn. Would anyone seriously offer to the world a graduating class of music majors who had never put a bow to a violin or fingered the keyboard of a piano?

Yes, I must admit that lobbying for a new environmental protection law or working with citizens to develop a scheme to conserve farmlands can become politically sensitive. The environmental studies program cannot take a party line on these issues, nor can the teacher use his classes as instruments for political action on his own pet proposals. The program however, can strongly urge students to become active in community service, following their own policy decisions arrived at freely after examing the arguments on all sides. In our program we support the campus environmental action club, called ENACT for short, by announcing its activities in classes and urging students to participate. It has its own autonomous program, and many members come from outside the environmental studies program, but we regard it as an essential component of environmental education on our campus.

Two things are noticeably lacking in the curriculum as it now exists. One is a laboratory in which students can learn to use instruments for environmental quality monitoring. Courses in instrumentation offered by the Electrical Engineering Department are too detailed and sophisticated for the needs, interests or abilities of most of our students. The other serious need is for a staff person to coordinate community relations so that students can go out and work with people in the surrounding communities in ways that will be advantageous to all involved.

As it evolved, the program has led us in the direction of what a local high school teacher has called "community-based education." Other programs in the university also send students out to the surrounding communities to obtain a firsthand experience in community problem solving. Currently some of the faculty are discussing a proposal for a community studies center that would coordinate community relations, provide administrative services and research facilities and develop some core courses on communities for programs that are to a large extent community based. These include Environmental Studies, Youth and Community Studies (which deals with such human problems as health, welfare, race relations) and Communications (insofar as it deals with the role of the communications media in community affairs). Several other programs in the social sciences, art and engineering could be coordinated through the center. In order for such a center to perform its functions effectively, it should have some full-time faculty, an administrative assistant and secretarial staff and it should have a clear mandate from the faculty and administration to provide coordination for community-based programs.

Session 13

A BUREAUCRAT'S PERSPECTIVE ON ENVIRONMENTAL EDUCATION

Sydney Steinborn

Earlier in this symposium those attending heard from Jane McCarthy of the Community Center for Crisis Intervention. Miss McCarthy is a professional intervener. That might also be a way to describe one of the things I do--namely, work at intervening in our environment. Last Wednesday and Thursday I was visiting one of our major environmental interventions in Montana and British Columbia--a half billion dollar project covering 45,000 acres of land and primarily dedicated to the last steps of converting solar energy into electricity. This was and is a major environmental intervention, and the burden of my talk both implicitly and explicitly will be a request for help from educators that will permit such interventions to proceed as gracefully as possible. My euphemisms are not meant to obfuscate--I work at environmental intervention on public works projects--like dams, highways and railroads among other things.

If as environmental educators, you react by thinking don't intervene at all or by saying don't go away mad just go away--that knee jerk response will not suffice. It may hurt my feelings but it won't do the job that educators must do while as a nation we make a substantial shift in our energy technology. This shift will take place even if we achieve negative population growth and zero energy growth.

Regardless of how any of us feel about it, the political climate is likely to lead to a program for national energy self-sufficiency which will probably call for a capital investment of over a billion dollars a week for the next ten years. Among other physical changes, the program calls for conversion to coal and oil shales as an energy source--a monumental change away from oil and natural gas with their relatively simple and developed infrastructures and technologies.

Suddenly we have become a nation that may dig up a good part of its backyard to find raw materials. Perhaps conservation, education and political action will

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reduce the scope of such a program but it will not be eliminated. Therefore it would be nice to know what "as gracefully as possible" means when applied to a major program of natural resource exploitation.

Whatever happens, educators will have a major role--no, let me put it more strongly--educators must assume a major role in leading us to environmental grace. It won't be easy, and the educational process will have to be multileveled--we need to develop an environmental ethic as a cultural trait while we seek by law and regulation--and by subtle and not-so-subtle pressures on decisionmakers--to avoid or minimize environmental insults.

Let's start with environmental ethic, why it is needed, where it would be nice to have, and how you might go about getting it. And I had better define it --so you will know what I am thinking of when I place the word "environmental" in front of the word "ethic".

Here is some paraphrasing from Webster's Unabridged Dictionary: "Principles of conduct governing an individual; or a socially accepted code; or a character or ideals of character manifested by a race or people--all in reference to the whole complex of climatic, soils and biotic factors that act upon an organism or an ecological community and ultimately determines its form and its survival."

I didn't paraphrase the last word--it matches this symposium's title on the flyer that told me to be here at this early hour on a Sunday morning.

Others at this symposium have established why we need an environmental ethic --survival as the issue. But as a practicing environmental intervener, as a practicing civil engineer in a public works construction agency, let me give an example of where an environmental ethic would be nice to have--possibly not with survival as the immediate issue--but certainly to prevent or minimize the loss of things that are nice to have and sad to lose.

Scenic mountain landscapes are nice to have and one way to lose them is by careless road construction. At present road construction in the United States is a multi-billion dollar a year program. How would you go about minimizing carelessness in this effort? How would you go about inducing an environmental ethic in the traditional bad guy of conventional environmental wisdom--the bulldozer operator, his bosses and his watch dogs, the inspectors hired by the owner --and remember the owner may or may not be a public body.

Since a synonym for an environmental ethic could be "cultural taboos" we in the Seattle District of the Corps of Engineers decided after much dialogue, foot stamping, field meetings, shouting and hand-wringing among our own designers, lawyers and inspectors to make the taboos part of our highway construction contracts by reference just the way we do with our safety manual. To make sure we were understood we used some techniques from the educational field: namely, a manual illustrated by simple cartoons and reinforced by on-the-job monthly training courses.

Did it work? Modestly. Our goal was prevention of environmental damage rather than restoration, but restoration was permitted under the contract and all too often turned out to be the way the contractor elected to perform. However, we made some waves--we educated through the communication process when we presented a paper on environmental design and construction response in Washington, D.C., about two years ago. The American Society of Civil Engineers subsequently published this paper in their National Construction Journal over the objection of at least one committee man--obviously a hard-nosed contractor who thought we had been seduced by the Sierra Club, and I have deleted the expletives.

The waves washed into Canada and I learned our little manual will be used in developing environmental control regulations--maybe taboos is the right word--for a proposed seven billion dollar trans-Canada pipeline.

Perhaps we would have been more successful then and more successful in the future if our manual simply reinforced or articulated cultural taboos that every child picked up while attending primary and secondary schools. I recognize that this seminar is directed largely to education at the college and graduate school level, but in terms of avoiding or minimizing environmental insults, you may be addressing only those people who induce or order environmental insults rather than those who make their living carrying them out. I also recognize that primary and secondary educators are a bit weary of assuming another cultural indoctrination role along with babysitting, sex education and equal rights. Still--

Some school districts are already working the problem. This thick book describes a program of urban-surburban environmental education for students in the fifth, sixth and seventh grades of schools in the metropolitan area of Seattle. It reads well and is certainly going to expose children to an environmental awareness, particularly to that relating to energy.

I do not have any facts relating to an evaluation of the program. A cursory evaluation by a professional in the field detected very little change in the students and elicited the sad comment that one teacher who conducted the course continued to walk across lawns and continued to litter in the customary manner.

I also have some questions on what I read in this book. Some of them environmentalists have heard before. The program was specifically required to be intercultural, but it looked very middle class and suburban to me. Then I was concerned with what you do when you have been successful in inculcating environmental taboos into a young person who wants to or is forced to be a heavy equipment operator and makes his living pushing the environment around with or without attendant social utility. Have we induced alienation because he or she is making a living in a way that was defined by the schools as anti-social? What will the parents think of a school system which denigrates the way the mothers and fathers are making a living? After all, educators must recognize that many people in the

United States make their living in the construction industry and, further, they too are middle class.

What is implicit in assuring that alienation will not occur in a program which seeks to cultivate inhibitions in exploiting the environment? Do these taboos call for a meticulously planned society? That is a society in which the government will assure that all jobs are consistent with cultural constraints induced in the schools or through peer groups or in models. Is this kind of planning possible in an open, continental society?

I am hoping that this aspect of environmental education will receive attention--we already have more alienation than we need. What can you do through education to reach zero alienation growth along with zero population growth and zero energy growth? Does what Titus Livy said 2,000 years ago to fellow Romans apply to us?*

Now I would like to spend some time on how educational programs can make professional environmentalists more effective in construction agencies. These are my ideas on how environmentalists can help environmental interveners achieve environmental grace.

Admittedly this will be a limited and subjective view addressed to those of you who would like to help an active young environmentalist become effective in a construction agency. I am assuming that the environmentalists want to be there because that's one place where they are really needed and where the pay may not be too shabby.

In a construction agency, an environmentalist will often occupy one of two hierarchical positions--staff or line. In a staff position they will be aides to senior executives who make the critical decisions or who prepare the final critical recommendations. Seattle City Light has this arrangement and has given it class and status by a beautiful office on the executive floor of their building. Another arrangement resulting, in part, from the workload generated by federal and state environmental protection acts is to concentrate all bird watchers in an environmental ghetto, that is, in a group consisting primarily of environmentalists and associated disciplines. This group will have line as well as staff functions. This is the arrangement in my division, where Dr. Steven Dice, a forest ecologist supervises a staff of 21, including four other Ph.D.'s --three in the environmental field. Whether line or staff or mixed, these arrangements can be very effective providing the incumbents have been prepared for the problems that go with making things happen in a bureaucracy. Obviously a key problem is communicating with action officers. Simplifying communication by establishing a mutuality of education and work experience is something which educators and their institutions can arrange.

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* "We reached those last days when we could endure neither our vices nor their remedies."

As an employer, I would like to see evidences of this on resumes. For students in the environment and related disciplines who want to become part of the action, I recommend exposure in the classroom and in the field to the stimuli that result in environmental impacts; exposure to the role of the infrastructure for supplying goods and services. By infrastructure I mean the roads, the canals, the waterways, the railways, the airports and their terminal facilities and their energy budgets and where the energy comes from.

I would especially recommend some first-hand experience with the micro happenings to the environment that occur when something is built. This may not be environmental education, but field exposure to construction is inextricably part of the education of effective environmentalists.

I do not think that a summer on a construction project with high environmental impact factors would result in the student being co-opted. If there were a joint effort by the school and the employer to make the experience educational, there would be even less chance that the student's environmental bearings would be altered, and there could be considerable improvement in future communication and mutual understanding.

I would also like to see student environmentalists and lawyers and doctors and engineers and political scientists and all those who aspire to professional positions or active citizenship learn something about bureaucracies. Perhaps those of you who are responsible for curricula associated with the social management of technology could assume this chore; in any event something has gone awry since Max Weber gave us his thoughts on bureaucrat. Now "bureaucrat" is a dirty word from which neither quality service nor goods are to be expected. This was not what Max had in mind--students and practitioners alike need to learn how bureaucracies work and how to make them work better for humans as well as for our other associates in the world's ecosystems.

My remarks should not be construed as indicating a feeling that student environmentalists should bear the total burden of bridging the communication gap between themselves and construction workers and professionals. The latter had better learn or relearn their environmental ABC's. A good time to do this is as undergraduates. Those who hope to be planners of projects that confront, insult or involve the environment need to know what upsets or is of concern to the opposition. Failure to recognize the tender spots of possible opposition can make planning of a construction project a hazardous occupation. My suggestion here may already be in effect in many places and calls for interdisciplinary courses on ecology for all undergraduates. I am opposed to a course in ecology designed especially for engineers as I am opposed to a course in literature similarly oriented. Instead, all campus courses in ecology should be structured in their late stages, that is, after the fundamentals have been covered, to highlight where conflicts occur and where resolutions appear possible and where not. Everything is not going to be resolved just because rational people are able to communicate better--differences may actually harden as we come to know more about what each of us wants, and that is good, too.

And in a final pass at college and graduate level education, let me suggest that greater attention be given to identifying secondary and tertiary effects of doing or not doing something. Economists like to call these externalities and environmentalists have learned to beat at planners with the externality club quite effectively. I would like to structure economic sociology courses that deal with externalities so that they have greater symmetry and all externalities are covered. This is one route to effective and accurate environmental impact analysis, and one that would appear to be a worthy goal of the environmental education establishment.

Now that the nation is energy sensitive, one common denominator in explicating externalities might be energy budgets--total energy budgets or systems energy budgets. This may bring us back to some of the technocracy concepts that were popular forty years ago--so be it. I would just like to see the concept be given more emphasis in our colleges and universities. This discussion of externalities --whether in the university or in primary schools--is one way to educate future and present consumers, and taxpayers, to accept the cost of environmental protection in products and services. In many cases, particularly those related to pollution, the environmental answer may be the least costly--all things considered.

Now what do I want as a supervisor in a tax supported multidisciplined planning, design, construction and operating agency? I am speaking as a customer of continuing education for our employees, remembering that in my own division which is concerned with public works planning and design, well over one hundred employees are professionals--with half-lives in reference to the validity of the training in their respective disciplines that can't be much longer than five years. We need to be continually updated, modernized, refurbished, and otherwise exposed to new ideas, attitudes and concepts. Colleges and universities are either the birthplace of these ideas or they serve as staging areas for their distribution. Good--we would like the opportunity for our employees to learn about the new, to expand and review the old and even to obtain advanced degrees in many fields including all those tangentially related to our environment. We would like to be able to do so in a wide variety of ways: by mail, by intensive short courses, by regular residence, in the evening, in the early morning, in the late afternoon or during regular work hours, on weekends, at the school or at the office or in the field. We don't expect the institutions that provide these educational services to lose money but we would like the lead time for setting up the course, courses or program to be no more than three months. This will permit early response to training needs and the development of plans in which the specified education can be arranged for within a reasonable time.

This is a good time to say that we are impressed with the education establishment's concept of sabbatical leave. It means that at best about 14 percent of their budget is devoted for retraining--at worst it may be only 7 percent and perhaps confined to faculty members with tenure. Either figure makes us very envious--our training budget is always very close to 1 percent--and I have never been able to get our personnel officer to say what figure is proper. What I would like educators to do is tell us--and our bosses in and out of the Congress --what you regard as appropriate. I said in and out of Congress because the problem of continuing education is not just confined to public agencies--it's a universal problem of people in the learned professions. I have listened to executives in large consulting engineering firms speak proudly of training budgets of less than one-half of one percent. Obviously they had forgotten that the teachers themselves felt they needed 7 to 14 percent--I just wish you would get that message to the outside world.

But let's get back to specific needs in the way of continuing environmental education. A big need is to lure the agency executives away from their desks into a situation that educates and exposes. The education would be in ecology; and the exposure would be to peer groups in government, industry, business, environmental education and environmental activism. Such a course is not directed simply to leading the builder, manufacturer, or developer to grace but also to exposing the professional and citizen environmentalists to the societal push behind construction, manufacturing, and land use changes.

The Thorne Ecological Institute's seminars in and around Aspen, Colorado, are close to what I have in mind even though they are too much fun and obviously upper middle class. The one I attended provided ecological education and also covered many practical and human aspects of why things are built or developments developed.

The model problem used at this seminar was quite real even though we proceeded by role playing and mock public meetings. Much was learned by all of the participants--and in a very short time. I would like to try the technique in our studies--it will be a form of public particpation that includes information transfer and I expect to call on educators and communicators for help.

Continuing environmental education, like all continuing education, is being proposed by many colleges and universities--by some professional societies, and by private and management and educational consultants. As a customer I would like to see someone pull it all together into an easily obtainable and readable shopping list. An educational clearinghouse might even avoid overlapping scheduling of similar courses and might permit certain institutions to specialize with assurances of full enrollment. Developing a clearinghouse looks like a good rationale for obtaining a Health, Education and Welfare or foundation grant --and developing a clearinghouse for environmental education seems particularly apropos for this symposium's host, the University of Washington's Institute For Environmental Studies. Certainly a master, nation-wide catalogue would help our training officers and career advisors of which I am one.

In this talk I have freely assigned the educational establishment a workload of substantial proportions. This shouldn't be permitted to detract from the job of educating us to be citizens in an open, albeit imperfect, democracy. This calls for teaching us techniques for reaching our elected officials and convincing them to enact laws--and to evaluate their implementation. What do I mean? To me citizenship means political participation--and we need help from educators to develop the skills, the techniques, and the willingness to communicate with legislators and government officials.

Finally, I hope that the educational establishment will recognize that even though there are programs for inculcating an environmental ethic in the primary schools, most of us who are on the job have not been exposed to this kind of primary education. Therefore, educators still have the job of packaging this message, this environmental ethic, this cultural taboo, in such a way that builders, operators and developers will get the message and will do something about it without experiencing negative psychological reactions. It is a challenging assignment and I am hoping that educators will accept it.

DISCUSSION

Question: I'm trying to put together a program at the master's level in a private university like yours. Did you do any market studies ahead of time, did you do a market study based on hiring scientists with interdisciplinary training?

Newland: That's right. And I might add that our biggest problem at the graduate level or at the master's level has been getting our students to finish their degrees before they went to work. We've had about half of our people hired away before they could finish the degree. They received such attractive offers that they never came back to finish their theses. Our biggest problem has not been finding them jobs, but getting them through school before they could be hired. Our program does not look as good to the administration as it should, because they're interested in the number of graduates, not the number of students.

Question: What sorts of courses did you have to initiate?

Newland: Well, you're probably aware that at a private school in most cases a lot of new programs are really bootleg or they're kind of bootstrap operations. Ours started similarly, therefore it did not get off to such an auspicious beginning. Now we have since gone back and revamped and reoriented. I'd say the number of new courses that we added were somewhere between five and eight. I don't know the exact number. It was over a time period. The university could not afford to do it initially.

Question: Let me just hypothesize. You take one of these highly intelligent, highly energetic students, give him good training, and at the point of serving internship, he or she gathers more information about the company than the company might want the student to have as an intern. Have you faced up to this?

Newland: Certainly. That was one of the first questions that the industrial people asked--"Well, what can we do if he assimilates certain information?" Our response to that was, "You're going to have to be careful about what you allow the student to do. You're just going to have to coordinate his activities within your

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J. M. Pappenhagen, of the Kenyon College Department of Chemistry, was the moderator for Session 13.

industry so that he will not be receiving confidential information." By and large, though, we feel it's the company's problem and not our problem. I'm not trying to take an isolationist point of view, but we feel that if they're doing something they shouldn't, then it's up to them to keep it covered up as best they can.

Comment: In my case, I get the students for a whole semester and teach a course from 9 to 5, five days a week. We take various topics: water, air, food and so on. Monday morning we have dedicated to presentation. We bring outside people in to speak. On Monday afternoon they have computer science and how that relates to the topic. On Tuesday, political activism and how that relates to the topic. On Wednesday afternoon, comparative literature search--what the local newspapers, the national newspapers are saying about the topic, and what are the sources of other information. On Thursday we have a bus trip, a field inspection trip to something pertinent to the topic. We have lectures on the way back to the bus. And Friday we have an exam, and after that we can prepare for the next week. The whole thing has science and technology at the base and political advocacy at the top, it makes a triangle with all the other disciplines going in. We give it for a semester, and hope that they can select from that where they want to go in the rest of their university career. This is for freshmen.

Collver: I think you have hit on one of the important solutions to our problem of getting students involved. I didn't mention, by the way, community involvement. It's very important. Get them in touch with people in the community.

Another is, get their mind off the next class they've got to go to. I see this sort of notebook mentality with students--ten minutes to the hour, they close their notebooks and their minds and they walk out. They actually seem to be afraid to get too involved in a subject, because it's going to be interrupted anyway. So why get all worked up? They have often said to me, "We should get together in a solid block of time without any interruption." And I think that's very good.

Question: What sort of, how many people are involved?

Collver: There are about 70 majors. The senior projects get about 30 students and the introductory courses are running about 200. It could be expanded to a lot more, but we don't have the faculty. If we advertised, we'd be swamped. I taught twice as many credit hours last year as I should have.

SUCCESSES AND PITFALLS OF INTERDISCIPLINARY RESEARCH PROGRAMS: THE RESEARCHER'S VIEW

Russell G. Thompson

"The good life is one inspired by
love and guided by knowledge."
Bertrand Russell, 1925

INTRODUCTION

Since June 1972, I have been the principal investigator of the National Science Foundation (RANN) Grant, "National Economic Models of Industrial Water Use and Waste Treatment," at the University of Houston. The primary objective of the research has been to evaluate the effects of increasingly restrictive environmental policy on resource use, waste discharges, and production costs of industry. To date, we have completed the development of a number of industrial plant models for national policy evaluations and have transferred these models to regional, state, national, and international users in industry, government and education. These models represent a systematic structure for evaluating, with a computer, the economic and resource effects of different environmental policies.

I am presuming from the invitation extended that you do not want an historical perspective of how we developed the research proposal, how we secured NSF (RANN) funding, or how we managed the project on a day-to-day basis. Instead, I am presuming that you want to know why I feel we have been successful in this effort and what the important pitfalls were in developing the models and transferring them to users.

Russell G. Thompson is Professor of Quantitative Management Science at the University of Houston (Texas). In addition to serving as principal investigator of the grant described in his paper, he has acted as consultant to several large industrial firms, was Chief of the Forecast Division on the National Water Commission staff, and has taught at several universities.

Brian Mar was the moderator for Session 14.

BACKGROUND

As you know, the basic operating unit in the university for faculty and students is the department; department chairmen report to deans who, in turn, report to the chief executive officer of the university. Resource allocations between colleges in the university are made by the chief executive officer.

Decision criteria of the department are directed to improving the discipline of the department. Decision criteria of the college are directed to improving related disciplines. Each dean's inputs to the chief executive officer are directed to improving disciplines. The chief executive officer can reallocate resources between colleges, but the college receiving the increased resources will use its criteria to allocate the increased resources to its departments. The department will use its criteria to plan the use of the gain in resources.

Tenured university faculty have guaranteed employment for every academic year and have generally received, until recently, at least cost-of-living increases over a period of years. Within the university, merit raises and promotions for faculty are heavily influenced by teaching performance and published articles in refereed journals; time spent managing an interdisciplinary project or publishing results of interdisciplinary research may neither support a merit review nor qualify for normal released time for research. Within the academic community, opportunities for professional advancement are greatly influenced by the contributions faculty make to new disciplinary knowledge.

Graduate students are primarily interested in (1) completing a dissertation (or thesis) that will be an academic contribution and (2) in securing a job with a graduate level income. With the interest of completing a dissertation worthy of academic notice, graduate students welcome financial support while completing the dissertation. Along with a desire for summer salaries, faculty members are interested in support for graduate students who may assist them with academic contributions. Faculty are additionally interested in maximizing benefits from their released time for consulting. Being on the payroll of a federally-supported research project will decrease released time for paid consulting with federal agencies; however, university pay will be the same.

Faculty members write proposals for possible outside funding; proposals are funded as a result of the ideas and analytical methods proposed, the professional background of the principal investigator, and the accomplishments of supporting staff. Grants are made by the funding agency to the university and are typically made for a year because of appropriation authorizations; however, adequate resolution of the problem may require sustained funding for many years. Expenditures of grant monies for salaries and wages must satisfy both the guidelines of the granting agency and the University An aggregate accounting is made each year to show how the University has used its overhead monies in general; however, no public accounting is made to show how the overhead monies were specifically used to assist indirectly in the performance of each funded research project.

The principal investigator has primary responsibility for technical direction and completion of timely research responsibilities. Certain research responsibilities represent project but not academic contributions. In addition, the research responsibilities entail a responsibility to transfer the results to users. These transfer programs must be developed by the principal investigator and the project staff.

EXPERIENCE

Within the university setting, I first tried to manage the project with faculty and graduate student participation from two colleges and a subcontract with another university. Faculty members were selected to direct teams of researchers from both colleges. Work plans were developed for each team; these work plans detailed the objectives for the team's research, the procedures for accomplishing the research, the expected accomplishments at different dates, and the resource requirements. Seminars for the project staff were held regularly to facilitate communications. The principal investigator met regularly with all the faculty team leaders to discuss problems. A detailed managment plan was developed. The system seemed ideal; however, certain teams produced; others did not!

At this point, I carefully examined how I could use the incentive system within the University and the direct monies of the grant to fulfill the responsibilities of the grant. I observed that I had mistakenly presumed that an inter-college program was necessary to successfully complete the interdisciplinary research responsibilities of the grant. This presumption was unfounded; in my case, it was not necessary to form inter-college interdisciplinary teams, because of the abundant supply of highly trained, industry-experienced chemical engineers in the Houston area and the relatively large enrollment of these engineers in the graduate programs of the College of Business Administration.

Discarding this mistaken presumption, I gradually developed a new management plan for the project. Full-time project staff were substituted for part-time faculty members with marginal project interests. The full-time project staff were hired to give the balance of expertise needed for model development. Part-time faculty and graduate student staff of the project were jointly recruited; a specific dissertation interest, which would represent both an academic and a project contribution, was identified with the graduate student and his advisor. The graduate student was asked to draft his dissertation plan and obtain the general approval of his committee. A work plan was then developed before the graduate student and his faculty advisor were put on the payroll. Industry experts were hired as consultants to assist the full-time and part-time project staff in model development. Both industry experts and members of the full-time project staff supplemented dissertation committees of certain graduate students working on project-related dissertations.

This new management plan allowed me to develop a highly motivated project staff. Full-time project staff receive all their pay from the project and are motivated to maximize professional contributions related to the project, to complete project responsibilities, and to transfer the results to users. These full-time staff members, in applying for any future position, will always have to account for the time spent on the project and the contributions they made on the project. Part-time faculty members and graduate students have important incentives to make significant contributions to the project. Part-time faculty members are supervising graduate students who have project-related dissertations. Graduate students are receiving financial support from the project to complete project-related dissertations and faculty members are receiving assistance in making academic contributions.

I have learned from my experience that the principal investigator must have management control of the project. He must be able to control who works on the project and how their energies are directed. This control must be exercised judiciously with a full understanding of (1) the incentive system in graduate teaching and research within the university and (2) the professional system of evaluation and rewards outside of the university. In addition, the principal investigator must have a balance between full and part-time staff to complete project work which entails both project and academic contributions. The principal investigator needs a full-time staff to maintain continuity of the project work, to synthesize the different modeling studies on a daily basis, and to make timely responses to the funding agency and model users.

I have recently learned from my experience in transferring developed models to users that these users must be shown how the models were developed and how the models can be used; they do not have to know how to develop the models themselves, but they must thoroughly understand the structure of the models and why they were developed in a particular way. Without this understanding users will not know the strengths and weaknesses of the models; and they will not know how to use the models wisely in resolving their questions. In addition, the users may find fundamental weaknesses in the models which require further model development. However, the present system of supporting the development of models and the transfer of models to users has certain serious pitfalls.

PITFALLS

Two serious pitfalls in developing and transferring models are (1) the lack of an assured continuity of the modeling effort and (2) a lack of incentives for effective transfer of models. As mentioned above, grants are typically made by the funding agency to the University for a one-year period because of appropriation authorizations. However, everyone concerned fully realizes that adequate resolution of the problem may require sustained funding for many years. The short-term funding of long-term projects makes it difficult to hire and maintain a full-time project staff for model development and transfer. Full-time project staff must be largely relied upon to execute effectively the transfer of models to users because the model developers must be available to assist the users when they need them. Graduate students generally are not available to assist users when they need them, because they accept alternative jobs with a graduate level income as soon as they complete their dissertation. Maintenance of a capable full-time project staff may be difficult because pay raises are limited by salary policies for the University faculty and staff; yet, University faculty and staff may have few responsibilities in common with project staff. In addition, the full-time project staff's job security is limited to the length of the grant.

SUCCESSES

As I see it, I have been successful as a researcher in managing a large interdisciplinary project and in technically directing the research of this project for the following major reasons:

(1) I was fortunate to have had the opportunity to identify the problem and to develop analytical methods for studying the problem in directing the forecasting effort of the National Water Commission;

(2) I was fortunate to have had a faculty appointment in the College of Business Administration in the University of Houston; the College has an excellent program in analytical methods of analysis and a relatively large graduate enrollment of highly trained, industry-experienced chemical engineers;

(3) I was fortunate to have had the same capable project monitor, Dr. Larry Tombaugh, since the first proposal was submitted to NSF (RANN); Dr. Tombaugh has allowed me considerable flexibility in both managing and technically directing the research; and

(4) I was fortunate to have had the first relatively large NSF (RANN) grant at the University of Houston where the precedent has long existed for the principal investigator to both manage the project and technically direct the research.

In this institutional setting, I believe that the following management strategy has contributed significantly to the success of the project:

(1) a workable, specific managment plan was developed, distributed, and implemented for managing the project and directing the technical research;

(2) a core full-time project staff was developed to assist in directing the technical research, administering the project, and communicating the results to users;

(3) the work of the part-time project staff was fully integrated into the graduate teaching research program, with all the project research staff participating in the graduate project-related seminar courses;

(4) the results of the research work were revised by leading experts and reviewed before submitting them for publication;

(5) the meetings of the advisory panel of distinguished experts provided a forum for presenting the model developments and results of the modeling work; and

(6) a genuine, continued effort has been made to assist users of the models to utilize the models in resolving their problems.

NEEDS

Resolution of important national environmental problems will require (1) the successful development of improved structures (models) for systematically evaluating the effects of policy and (2) the effective transfer of these improved structures to users. What is needed to successfully develop these structures and effectively transfer them to users is a continuing institutional base whose primary objectives are directed solely to resolving important national environmental problems. This continuing institutional base needs to be able to contract directly with private and public sponsors of research. All of the monies granted need to be specifically used to assist both directly and indirectly in fulfilling the objectives of the research grant. The principal investigator needs managment control of the direct project monies to control who works on the project and how their energies are directed.

The institutional base needs continuing financial support to maintain a full-time project staff to assure continuity for the period of time required both to successfully develop the models and to effectively transfer them to users. Principal investigators need to be appropriately rewarded for successful management of an interdisciplinary project; and project staff members need to be appropriately rewarded for successful model development and transfer of models to users. Life of the institutional base should terminate at the end of the period of time needed to resolve the identified national environmental problems of importance.

The University could develop this type of continuing institutional base for resolving these identified problems. However, marginal modifications in the present system will not generally suffice. Interdisciplinary problems of national importance are not likely to be solved by using staff members from separate disciplines whose incentives for performance are virtually all based on incentives in these separate disciplines. The wisdom of modifying the structure of the University to solve both interdisciplinary and disciplinary problems needs careful, soul-searching thought.

In closing, I would like to state that new institutions for the resolution of important national environmental problems are clearly needed. The wisdom of mutating the University to achieve effective resolution of both interdisciplinary and disciplinary problems needs to be seriously and openly debated. In the long-run interest of the nation, everyone may be better off if capable leaders of interdisciplinary research are encouraged to create new institutions and to operate them in the public interest to resolve important, interdisciplinary environmental problems.

Session 14

MUTUAL INFLUENCE OF INTERDISCIPLINARY RESEARCH AND ENVIRONMENTAL MANAGEMENT

D. A. Bella and K. J. Williamson

INTRODUCTION

The purpose of this paper is to examine the close relationship between environmental research and management. We will focus on the nature of disciplinary research and its relationship to basic environmental decision-making assumptions. We will stress that the broad nature of environmental problems necessitates increased interdisciplinary research efforts.

A number of significant difficulties encountered in interdisciplinary research will be discussed. Many of these problems result from differences in disciplinary communities and from institutional constraints. However, these difficulties also include the possible reluctance of environmental management to respond, support or even tolerate the innovative and even radical results which will likely arise from interdisciplinary studies.

DISCIPLINARY DOMAINS AND PARADIGMS

Science and engineering are cooperative social enterprises which involve human communities committed to certain ambitions and attitudes (1). Strong commitments exist within such communities to "proper" approaches to problem solutions which provide discipline to members' activities. The nature of these commitments is related herein to two features of disciplinary communities: domains and paradigms.

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The domain of a disciplinary community encompasses activities of interest to the communities' members. A disciplinary domain is described by two related characteristics: 1) the objects examined; and 2) the behaviors, features, relationships and problems associated with these objects. A disciplinary community is largely identified by its domain. For example, hydrodynamics can be broadly described as the study of water and its motion and action. A disciplinary community is committed to rigorous solution of problems which fall within its domain.

A disciplinary community possesses a constellation of concepts, procedures, models, examples, and experiences which have proven useful within the disciplinary domain. Such a constellation and the attitudes, ambitions, and mental frameworks consistent with it are termed herein the paradigms of a disciplinary community (2). The paradigms may be considered as epistemological and methodological tools of a disciplinary community. The domain and the accepted paradigms provide unique identity for each disciplinary community.

Paradigms serve as guides and patterns for community activities. "Acceptable" problems can be addressed only through use of established paradigms. "Acceptable" approaches to problem-solving follow the patterns of the paradigms. "Acceptable" explanations and observations are compatible with the paradigms. Thus, the paradigms of a scientific or engineering community act as filters for selection and evaluation of "appropriate" problems, approaches, explanations and observations. Without them, disciplinary rigor, stability and orderly progress could not be maintained.

Individuals within research strive and compete for recognition and acceptance from their disciplinary communities. Often they establish personal identity through their work, and thus, criticism of their work is often viewed as personal rejection. Disciplinary communities demand that research results be observable, reproducible and defensible by other community members and work below these standards is rejected. Thus, researchers are reluctant to depart from established community paradigms; in fact, members' activities typically are confined to small sub-regions of their disciplinary domain where established paradigms can be confidently applied. Most serious researchers feel threatened from unfamiliar domains and foreign paradigms. Consequently, most research involves the application of established disciplinary paradigms to problems of current interest which leads to a gradual refinement and evolution of these paradigms.

Individuals become deeply committed to their disciplinary paradigms because the paradigms effectively perform two functions which give the individual professional and personal identity. First, they provide established patterns or guidelines for "correct" and "expert" approaches to approved problems. Second, they provide means for recognition and acceptance. The motivations of researchers are significantly based upon the strong desire to obtain such recognition and acceptance. A common ambition is to become a recognized expert within a chosen sub-region. A strong agreement within the community exists to what constitutes "appropriate" behavior and recognition for such behavior is consistently provided.

In summary, disciplinary paradigms are necessary for disciplinary rigor, stability and orderly progress; they effectively provide a framework for the selection and solution of problems. However, since they offer both the pathway to and means of recognition for successful problem solutions, many individuals become deeply committed to their use as the only framework. For many, such commitments become so strong that the images provided by the paradigms are considered reality itself. Some individuals, often those most strongly committed, believe that paradigms do not exist. To them, there is only the right way to approach a problem which, of course, is their way.

BASIC ASSUMPTIONS FOR DECISION-MAKING

Few would disagree that effective environmental management must be based upon reasonable decisions. Unfortunately, however, the meaning of reasonable decisions has not been adequately pursued. A confusion appears to exist between the requirements for reasonable conclusions as demanded by disciplinary communities and the requirements for reasonable decisions for management. Reasonable conclusions and decisions both are dependent upon information acceptable under the disciplinary paradigms. Conclusions and decisions, however, differ with respect to the required adequacy of available information. Conclusions are withheld until available information is deemed adequate. In contrast, decisions typically are made within temporal constraints using information presently available.

A Decision-Case Approach

The assumed adequacy of available information represents an important characteristic of the decision-making process. Consider a decision-making spectrum which spans a range of assumed adequacies of available information. At one end of the spectrum, decisions are based completely upon certain information. As one moves toward the other end, decisions are more strongly influenced by a recognition of the inadequacy of available information. Thus, the spectrum ranges from complete certainty to relative indeterminancy of outcomes. For the purpose of this discussion, four decisions cases along this spectrum have been identified (3).

Case 1 - Certain Outcome. Decisions made under Case 1 are based only upon reasonably certain outcomes. The decision-making process strives to maximize the total value of these certain outcomes. Outcomes of negative value, particularly those of large magnitude, are avoided. The probability of occurrence of an outcome or impact must be near unity to influence decisions. Possible outcomes whose probabilities are less than unity are considered as inappropriate determinants of decisions. Outcomes which are accepted as reasonably certain are commonly those outcomes which have already occurred; thus, Decision Case 1 tends to be reactive rather than preventive. However, future outcomes may be considered when their occurrences are rigorously predicted under established paradigms as being reasonably certain.

Case 2 - Uncertain Outcome with Probability Specified. Under this decision case, a probability of occurrence is assigned to each potential outcome. The probability need not be one, as required in Decision Case 1. Decisions are based upon the summation over all occurrences of the probability of an outcome times the perceived value of that outcome held by the persons establishing decision priorities. Only rarely do they reflect the more objective basis, frequency of occurrence. Such degrees of belief can be strongly influenced by the extent to which established paradigms predict given outcomes. Under this decision case, outcomes whose values have high magnitudes, positive or negative, will influence decisions even though the probabilities of such outcomes might be considerably less than unity. A wise gambler usually operates under Decision Case 2, providing that the stakes are not too high. Classical decision theory also falls under Decision Case 2. The objective of Decision Case 2 is to maximize the total expected value of outcomes.

Case 3 - Uncertain Outcome with Probability Unspecified. Decision Case 3 is based upon the assumption that the probability of occurrence for some outcomes may be unknown. Decisions are influenced by possible outcomes even though the probability of such outcomes may be unknown. This decision case is dominated by the possibilities of catastrophic outcomes (outcomes of large negative value). Such outcomes are avoided, even though their probabilities of occurrence are unknown.

Case 4 - Unspecified Outcome. Under Decision Case 4, it is realized that some of the most significant outcomes may not be even recognized as possibilities. Decision Case 4 incorporates decisions to avoid adverse consequences of unknown outcomes. Under this decision case, it is necessary to examine the nature of catastrophic outcomes and essentially adopt strategies which unspecifically avoid such outcomes. An environmental management strategy based upon this decision case has been previously developed (3).

In summary, Decision Case 1 is based upon only certain outcomes. Decision Case 2 does not require complete certainty, but probabilities for each outcome must be specified. Decision Case 3 does not require the specification of all probabilities, but all possible outcomes must be identified. Decision Case 4 recognizes an inability to specify all possible outcomes. These decision cases reflect different degrees to which available information is considered adequate. If the certainty of Decision Case 1 is demanded for acceptable decisions, then sufficient knowledge must be assumed available to describe such certainty. At the other extreme, Decision Case 4 is only reasonable if one assumes that available information is not adequate to predict the occurrence of all possible significant outcomes. These four decision cases are similar to Ackoff's (4) three classifications for knowledge of the future: certainty, uncertainty and ignorance. The difficulty of specifying the values (experienced qualities) of outcomes is recognized; however, we will not pursue this important problem here. (For a discussion see Bella, 1974 (5).)

The Dominance of Decision Case 1 in Environmental Management

Decision Case 1 has served as the principal model for environmental management decisions, particularly those involving non-trivial social and economic changes. While Decision Cases 2 and 3 have also been employed, their non-trivial use typically meets strong resistance. The certainty of Decision Case 1 has served as the ideal to be pursued. This commitment to Decision Case 1 has been expressed in many ways. For example, a strong reluctance exists to take action until conclusive facts are available. As a result, the word speculation is often taken to imply irresponsibility. The belief that environmental degradation should be proven beyond a reasonable doubt is another expression of the commitment to the certainty of Decision Case 1. In contrast to environmental-management decisions, military decisions have relied heavily upon all four decision cases. The uncertainty and indeterminancy of potentially catastrophic military situations has justified a preventive strategy which demands large sacrifices and expenditures to support reserves, multiple options, intelligence gathering and research.

Within informal talks, environmental research personnel often are critical of environmental management. Basically, this criticism can be viewed as an implicit indictment of Decision Case 1 dominance. However, the contribution that environmental research itself makes toward the domination of Decision Case 1 is seldom noted. To understand this contribution, we must recall that these decision cases are differentiated by differences in the assumed adequacy of available information.

Research personnel are primarily educated to withhold information until the available information is deemed adequate to make a reasonably certain statement (a conclusion). Recognition and acceptance of research results by disciplinary communities comes through publication of conclusive results which rigorously conform to disciplinary paradigms. Because research personnel are strongly motivated by colleague recognition and acceptance they are extremely careful not to publish results which might be below the accepted standards of the community.

This commitment of research personnel to such conclusive results is not based upon an assessment of appropriate environmental decision strategies. Primarily it results from the requirements for acceptance and recognition by the disciplinary communities to which they belong. A tendancy exists to confuse, merge and even equate these requirements for rigorous disciplinary conclusions with the requirements for environmental decisions. The overall result has been a strong bias toward Decision Case 1 in all environmental management.

Environmental research also is influenced by the financial and social dependency of research personnel upon existing institutional structures. Income, identity, title and status are provided by such institutions and individuals are reluctant to risk their loss. Consequently, research problems which could lead to disruption of institutional ties tend to be avoided. Research results critical of supporting institutions and their policies tend to be withheld until evidence is overwhelmingly conclusive. Thus, environmental researchers tend to confine their research activities to disciplinary domains where they are likely to obtain conclusive results which will cause a minimal disturbance to institutional and financial organizations on which they depend. These attitudes also tend to bias environmental decisions toward Decision Case 1. Informal discussions among researchers, however, typically range over wide domains and often are extremely critical of these organizations.

Environmental Criteria

Criteria are often employed as environmental management tools. Rarely are such criteria based on conclusive information; however, such criteria make it possible for environmental scientists, engineers and managers to arrive at reasonably certain conclusions. It is relatively easy to conclude that a given set of conditions either do exceed or do not exceed a given set of established criteria. Thus, criteria enable the scientist, engineer and manager to function under the requirements of Decision Case 1. This relatively comfortable condition is disrupted, however, when these criteria are employed to justify non-trivial social and economic changes. Then, criteria are often attacked on the basis that they do not conform to Decision Case 1; that is, the criteria are not based upon conclusive evidence. Often such arguments are accepted and criteria are altered to better conform to existing social and economic conditions. The defense of criteria under the demands of Decision Case 1 is far more difficult than the determination that specific conditions exceed the criteria.

While environmental criteria can be important management tools, it must be recognized that they create illusions of certainty. When existing social and economic conditions are challenged, this illusionary certainty is attacked and used as a justification for altering the criteria. Thus, the illusion of certainty often created by criteria is frequently accompanied by an illusion of decisiveness.

THE ENVIRONMENTAL PREDICAMENT

The dramatically increased technological capabilities of modern societies have resulted in a human capacity to produce significant undesirable ecological impacts. A major objective of environmental management is to avoid such undesirable conditions. However, such a task has become immensely difficult because of the global scope of human activities and the inability to be isolated as single causes or solutions to human impacts. The most significant problems created by technological societies simply cannot be decomposed into traditional disciplinary domains.

In a previous study, the implications of human capability to alter ecological systems in greater and more complex ways was examined (3). It was concluded that an environmental predicament exists which can be stated as: our ability to modify the environment has increased and will likely continue to increase faster than our ability to foresee the effects of our activities. The environmental predicament strongly suggests that our inability to determine the total consequences of our combined actions must be recognized. The inability to specify environmental outcomes with a high degree of certainty and our expanding capacity to significantly alter our environment forces us to reject the constraints of Decision Case 1. The demand for reasonable certainty of occurrence cannot be justified in the face of possible catastrophe. Uncertainty must be dealt with as expressed in Decision Cases 2 and 3. Moreover, we must increasingly recognize that the most serious outcomes may not be even perceived as possibilities; therefore, environmental strategies must be increasingly preventive under the assumptions of Decision Case 4 (3). The implications of these conclusions upon environmental research are significant.

ENVIRONMENTAL RESEARCH

Environmental research generally has been performed through the traditional disciplines, which has resulted in two significant deficiencies. First, the scope of most significant problems often exceeds the domain of a single discipline. Second, the demands for rigorous disciplinary work (compatibility with established paradigms) tends to promote the assumptions of Decision Case 1. Both of these characteristics of disciplinary research can be deterimental to environmental management.

The commitment to disciplinary domains and paradigms, however, is largely responsible for the orderly progress of scientific and engineering knowledge. To maintain such progress, the disciplinary community must judge what contributions are relevant to the domain and meet the standards of the community. This commitment to limited domains and paradigms does limit a community's effectiveness for research; however, this commitment also provides rigor and stability to the progress of its knowledge. The rigorous demands of disciplinary communities, their selective development of research results within their domain, and the recognition and acceptance given to individuals who meet the demands of the community have all contributed to the orderly development of scientific and engineering knowledge (6). These community characteristics, however, are generally not supportive of the environmental research relevant to Decision Cases 2, 3 and 4, nor do they encourage the pursuit of the broader problems resulting from our expanding technological capabilities.

Recently interdisciplinary research has been suggested as a means of avoiding the deficiencies of disciplinary research. Through such research, problems which span several disciplinary domains might be addressed. However, the process of accepting and recognizing quality interdisciplinary work has not been sufficiently examined. Individual researchers are highly motivated by acceptance and recognition by established disciplinary communities. The basis for disciplinary acceptance, however, can directly conflict with the type of problems addressed and the research methods applied beyond the disciplinary domain. Consequently, interdisciplinary studies tend to degenerate into multi-disciplinary approaches in which individual investigators gain their recognition primarily through traditional disciplinary communities (7).

This problem is not only limited, however, to the recognition and acceptance of individuals. Evolution of interdisciplinary concepts requires some mechanism of judgment so that acceptable concepts are selected and further studied. Such judgment is necessary for interdisciplinary concepts to evolve. Without such a mechanism, the selection and evolution of concepts depends primarily upon their acceptance within traditional disciplinary domains which clearly is not adequate.

It is difficult to imagine the type of community which could maintain an evolution of interdisciplinary concepts. For the present, disciplinary communities will likely play a major role in determining the survival and evolution of interdisciplinary environmental research. Hopefully, collaborative interdisciplinary research teams and associations will survive long enough to influence the selection and evolution of truly interdisciplinary paradigms. New communities also can be expected to emerge. While it is not possible to describe the actual selection system appropriate to the progressive and orderly growth of meaningful interdisciplinary environmental paradigms, the following three significant tasks should be met by any such system.

1. The selection of the best interdisciplinary research results must be accomplished without heavy bias to the breakdown of problems and systems into disciplinary domains.
2. The consecutive building upon the best interdisciplinary results must be encouraged so that such results support future work.
3. The demands for quality research results must not be confused (directly or indirectly) with the demand for decision certainty (Decision Case 1). Quality research must support decisions which recognize the undertainty (Decision Cases 2 and 3) and indeterminancy (Decision Case 4) of environmental outcomes.

The Future of Interdisciplinary Environmental Research

Interdisciplinary environmental research is highly vulnerable to criticism since it lacks established communities and established ways of approaching problems. In addition, its character is not reflected in social and institutional organizations. For example, most universities are structured around traditional disciplines and often interdisciplinary activities do not meet institutional constraints (8).

Interdisciplinary environmental research will be faced with the demand to produce practical and useful results. The meaning of practical and useful will largely reflect the basic assumptions of the environmental management strategies. From the perspective of this paper, two basic directions that environmental strategies can follow are identified. Both directions will have a significant influence upon the nature and character of future interdisciplinary environmental research. The first direction places heavy reliance upon assumptions of Decision Case 1, the certain outcome case. The second direction emphasizes the uncertainty and indeterminancy of environmental outcomes, and thus stresses the assumptions of Decision Cases 2, 3 and 4. The meaning of the words useful and practical will be largely dependent upon which direction is taken.

If established environmental strategies tend towards the assumptions of Decision Case 1, two characteristics of interdisciplinary environmental research can be expected. First, research will tend to break problems down into workable domains from which concrete results can be obtained. It is unreasonable to expect research to develop the concrete results demanded of Decision Case 1 unless the complexities of problems are reduced by decomposition into workable (usually disciplinary) domains where established paradigms can be employed.

The second research characteristic resulting from Decision Case 1 is a tendency to focus upon problems which have already occurred. The input of environmental research results into the decision-making process will primarily occur after actual problems have been observed. The demand for reasonable certainty can be effectively met by reporting actual observations. A major function of environmental research then will be to monitor for potential environmental impacts. Then, after actual impacts have been observed and documented, input into the environmental management process will be accepted. What can be more certain than the documentation of problems that have already occurred? Constrained by the requirements of Decision Case 1, environmental research will be largely descriptive, and occasionally prescriptive. Such research, however, will be seldom preventive, except for the most obvious types of problems.

If environmental management is based largely upon a recognition of the uncertainty and indeterminancy of environmental outcomes, then environmental strategies will largely be based upon the assumptions of Decision Cases 2, 3 and 4. Under these assumptions, the words useful and practical will have a radically different meaning for environmental research than would be possible under the constraints of Decision Case 1. Consequently, the type of interdisciplinary environmental research which is encouraged in the name of practical and useful would be radically different. It will be recognized that the most important problems may at anytime be unperceived so that a primary goal of environmental research must be to identify problems and gain a better understanding of systems behavior. A major part of environmental research would be directed toward the basic relationships of ecological systems of which man's culture is an integral part (3). The identification of possible problems will be considered useful despite the absence of absolute certainty. If, however, management strategies are constrained to the assumptions of Decision Case 1, the kind of research described above will generally be considered impractical. Consequently, the pursuit of such research will not receive support. In short, the type of research demanded under Decision Cases 2, 3 and 4 will be considered impractical or unreasonable if decisions are dominated by the constraints of Decision Case 1.

It is our belief that environmental management strategies must be based upon the recognition of ecological uncertainty and indeterminancy. We must recognize that collectively we have the capacity to significantly alter ecological systems in a manner that we are not able to predict. This clearly calls for a preventive environmental strategy which is based upon the general assumptions of Decision Cases 2, 3 and 4. In particular, Decision Case 4 must be increasingly employed. Under the dominance of Decision Case 1, it is difficult to imagine how modern society will be able to cope with the expanding magnitude and complexity of environmental problems. Moreover, under this dominance, it is difficult to imagine how the potential of interdisciplinary environmental research might be effectively employed.

Further Considerations

Let us imagine that the potential of truly interdisciplinary research is applied to the examination of our expanding environmental problems. We believe that several attitudes will emerge which differ from those of the more traditional disciplinary research. First, currently recognized problems and concerns would be considered as symptoms of more basic problems and concerns. Second, we would be confronted with the necessity of examining and clarifying basic human values. Third, the solutions to basic problems and the responses to clarified human values would point toward significant changes in life styles. These attitudes might challenge a number of established customs, attitudes, and beliefs. Some of the more influential individuals and organizations in technological societies may not be receptive to such challenges. Constraints on environmental research and reduction of funding could result. Such pressures can further complicate the difficulty of maintaining responsible and quality interdisciplinary environmental research which is relevant to the expanding problems of technological societies.

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Editor's Note: Russell F. Christman of the University of North Carolina was kind enough to speak in Session 14 when another participant was unable to come at the last minute. Unfortunately, the tape recorder malfunctioned near the beginning of his remarks, and no manuscript was available. Among the things he discussed were some of his own experiences with interdisciplinary projects, including one on acid rain at the University of Washington; some general characteristics of interdisciplinary work; and the way universities are handling this kind of work.

GOVERNMENT, CREDIBILITY, UNIVERSITIES AND ENVIRONMENT

Stewart Bledsoe

I came to do a specific thing. I want to place the order for some of the unstated issues that quite possibly have not been laid before this meeting, at least not by anyone speaking for the government sector.

I recognize it puts me in the role of "Devil's Advocate", and some feathers will be ruffled. But until both sides of the issue are inspected, this session is mostly calisthenics. And the real world is anything but that.

My background in the legislature, representing a rural constituency, gave me the running room to be more than a casual participant in helping enact some pretty decent environmental legislation. Our state established a Department of Ecology, the first in the nation. We made an early basic decision to do something about our environment, deciding that we would not live in a sewer, choke on our stink, or be buried by our own waste. It was my pleasure as the House majority leader to be in the forefront of this move, a somewhat unseeming role for someone from "hick America". You would think that the push to accomplish this kind of a breakthrough would emanate exclusively from the urban segment of our state. Incongruously enough, it did not.

I would like to give you a reading on the "state of the environment". If you read it on the interface, where such a state is eventually decided, that's in the political arena. It is in the political forum that the world of science, the world of economics, the world of dreams and the world of actualities all come together. My reading is that continued progress towards environmental quality in this nation is far from guaranteed if it must be maintained in the political arena. The Federal Environmental Protection Act, which I regard as a pretty decent piece of legislation, was written by men, and will be taken apart by men, if they so choose. The wording is not frozen in concrete. It is not cast in a mold of iron or steel. It is almost written on sand. If the act is not properly attended to, it could be restructured, probably downward.

Stewart Bledsoe is Director of the Washington State Department of Agriculture, and a former member of the Washington State House of Representatives, where he served as majority leader. A former rancher, he was a director of the Washington Cattlemen's Association and Cattleman of the Year.

With this very tenuous balance, I regard the role of education, particularly the universities, in maintained equilibrium, as three-fold:

First, to maintain credibility of the environmental attempt;

Second, to provide a rational data base;

Third, to provide nuts and bolts technique for doing the job.

Let's take it from the top.

CREDIBILITY

We had an infestation in our national forests of the particularly unpleasant tussock moth. During a particularly unpleasant year we saw about 800,000 acres of standing forest injured or killed. And we suffered this invasion while forest managers stood handcuffed, unable to use the only chemical available to control this infestation because of a walkaway led by some university scientists who predicted an environmental Armageddon, which subsequently did not occur. The proposed use of a particular unpleasant chemical, DDT, elicited a knee-jerk reaction from many university-types, which presented the EPA with no alternatives other than to totally deny the first year's request for insect control.

In the second year when an exceedingly tightly controlled DDT application was granted at less than a pound per acre rate, there was a 98 percent kill of the moth population in the area and a reduction to very nearly zero of any insect damage to the forest. But the initial discussions were hampered rather than aided by the inability of many academic spokesmen to present believable alternatives and, even more importantly, help in measuring the tradeoffs between environmental hand-wringing as opposed to the environmental effect of doing nothing.

It must be assumed that we are a society capable of reason. If this is the case, then one would hope that the leadership for much of that reasoning capability could emanate from the campus. And the role of the academic world in the future must be that of maintaining rationality in these kinds of discussions rather than fueled with emotionality. Nobody gains. Everybody loses. And the credibility of the entire environmental movement is eroded by decisions made under emotional heat which subsequently must be corrected. Look at the hassles of cyclamates, Diethylstilbestrol, Super Sonic Transport-induced skin cancer, etc.

The second educational role is maintainance of a reliable data base. The decisions which must often be made in a political arena are admittedly made without adequate data. They are often made on the basis of decibel level of the statement or the clout of the statement maker (How many people are behind you? What organization do you represent? How active, how vigorous?) rather than what is real and responsible. A classic case of this took place in our state recently. We were challenged with some decisions on the effect of some pesticides in some orchards and the resulting environmental impact, particularly on the human environment. Strong questions were raised as to the effect on workers reentering orchards following spraying applications. A blanket policy was issued by the Department of Labor on an emergency basis which was based on some preliminary work performed in an environment totally unlike the one existing in the State of Washington. The Department of Labor (and in their turn, EPA) said, "We will impose a blanket solution on the entire United States" (just as if anybody could put a blanket over the United States) that established some reentry standards that might have made sense in an almond grove in California or a citrus grove in Arizona. But when translated to a Washington State apple orchard you have, instead of a shrouded tree growth, an open limbed tree; instead of a dry dirt understory, an absorbant green grass understory; and, instead of a Southern California humidity, a desert-type atmosphere where we irrigate to provide moisture.

In other words, we are talking about two totally different environments. Not the single blanket environment. But the primary answer necessary for a national decision; i.e., a data base related to the actual environmental conditions to be regulated by these proposed reentry standards, was totally unavailable at any university station. The data base answer needed to resolve the impasse was found in a laboratory maintained by a state health department in a small town, Wenatchee. It is saddening to note that this was the only current data available on measuring the effects of this type of reentry and this kind of an environment which was available in the entire United States.

One would hope that much of this data could have been made available at the University of Virginia, where the United States Department of Agriculture maintains this kind of research capability, but never asks those kinds of pertinent questions. Or if not that, the University of California at Davis. Or, why not the Washington State University at Pullman? But the answer was not found there. It was found in a health lab in a remote non-campus situation.

On the plus side is a classic role performed by Washington State University in providing the data base to unlock another chemical dilemma--the tug-of-war between two branches of agriculture over the use or misuse of 2,4-D. Wheat growers must have this chemical to maintain economic weed control in their ranching operations. But if the application is improperly done or improperly timed, it can result in air mass pollution in damaging drifts as far as 70 to 80 miles away from the point of application. We have authenticated these instances but have no explanation for them.

We are finding the answer to what, how much, how far, under what conditions, from research performed by Washington State University right out at the field level. It is a pleasant act to watch. Out of academia are emerging some real solid inputs that are providing the data base that will permit, even in the political arena, a rational decision to be made. By the manner and the quality of response, the maintenance of environmental credibility is enhanced. You'd better believe that the Washington State University looks pretty good in the eyes of a very critical agriculture constituency.

Thirdly, the universities could well devote their energies to coming up with nuts and bolts. It isn't glamorous. And it's not the type of thing that often interests campus researchers. But somebody should do it. And if it could emanate from campus, it would be a highly meaningful contribution. Let's take a couple of simple cases in point. We have made a national commitment for clean water. That was easy to do. But the actual doing is something else. There are going to be some real moments of agony when the impact of non-point discharge standards are brought home to irrigators. Which means that someone is going to have to help devise the means, the mechanisms, the technique, the changes in irrigation practices, the operation and maintenance of settling basins, the cost factors in recycling water. In other words, someone is going to have to put together the data base that will help in this transition from yesterday's irrigation practices to tomorrow's. And, most particularly, how much it costs. It would have been helpful at the time that the national commitments were made if these cost estimates were available. Perhaps we would have taken a second look at the length of stride that we so blithely committed ourselves to.

Or in the backyard of Spokane. There's an agricultural industry in real jeopardy: the grass seed business. From a nuts and bolts determination could have come information that might have tempered the mandatory edict that says, "No Smoke Here." And without the physiological challenge of field-firing to the rootstock, the maintenance of a seed industry is all but impossible.

Can we provide some answers on how to grow this crop, how to continue to challenge the physiology without performing some insult to our environment? One would hope that as a reasoning, intelligent people we could devise a way. With the right kind of minds working the problem, I am sure a way will be found. Hopefully, from the universities will come the answers to what that way is, and more particularly, the dollar figure.

In closing, let me offer a piece of advice. From the legislative arena, I have functioned as a friend of the environment. If there is one facet which makes the continued passage of environmental legislation a matter of doubt, it is the tendency of the environmental advocates to be fiercely beady-eyed. Too often the desire to do a very decent thing--to make the environment a better place--creates a certain missionary zeal that we alone know the way. And any who would ask to put their hand on the drafting pen alongside ours and temper our proposals become enemies of the environment, when in fact many times they are not. Let's not assume that because we believe in environmental quality, that only we know anything about it.

And finally, this. The role of universities and all who would educate in the direction of environmental concern boils down to this. Let's make sure that we educate as our primary goal, rather than indoctrinate. In some cases we have lost track of what it was that we came to accomplish. We have in some cases ceased to emphasize education, particularly education which can consider some of the trade-offs, education that would dare to consider that we might not be able to do-it-all in one giant step. We have developed educational programs which are pure indoctrination. My reading is that we can do some of both. Let's face it. It has to be some of both if education is worthy of the name.

HOW CAN UNIVERSITIES HELP STATE AND LOCAL GOVERNMENTS WITH ENVIRONMENTAL PROBLEMS?

David A. Aggerholm

I must begin by relieving the University of Massachusetts or the Massachusetts Department of Public Works of any responsibility for my remarks. They are my own and do not necessarily represent the viewpoints or policies of either organization.

After considerable thought about the subject for this session, I decided that it would have been more appropriately titled "Can Universities (or, more properly, the Academic Community) Help State and Local Governments with Their Environmental Problems?" I say this because my experience and observations from both sides of the fence have raised serious doubts in my mind about the answer. To put it more bluntly, I don't think the academic community has done much in the past to help government at any level solve its environmental problems and isn't doing much now, notwithstanding considerable lip service, some sincere attempts and a few notable successes.

Within that context, I will focus my remarks on four fundamental questions:

- --Why does government at all levels -- local, state and federal -- need help?
- --Why is the academic community a logical place to expect that help to come from?
- --Why haven't academic-governmental, problem-solving relationships been very effective thus far?
- --How can effective academic-governmental problem-solving relationships be achieved?

Considering the time allotted to me and the breadth and complexity of the subject, I will be forced to generalize and oversimplify to some degree. Thus, I'm certain that many of you will take exception to some of what I say. I hope so, for my interest is to generate some discussion on these questions in hopes of improving government-academic relationships, which I'm sure we can all agree need some improvement.

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I should qualify here also, that I will discuss these questions in the context of the problems facing governmental agencies--bureaucracy if you will--as opposed to the legislative or judiciary branches of government. I recognize that these branches of government also need help but I think the lion's share of the problems and needs exist in the agencies.

Why do government agencies need help? And they do need it, more than ever before. Government agencies at all levels are experiencing unprecedented pressures for change, or at least for re-evaluation of virtually every aspect of what they do, how they do it, and even why they do it, as the society which they exist to serve demands from them a greater responsiveness to social concerns and consequences (i.e., people are demanding that government do its job for people not to them). In the process, most government agencies are being besieged with new or changing policies and programs which are presenting challenges and problems requiring creative, imaginative approaches, and knowledge and skills which do not exist at all or in sufficient quantities within the agencies. At the same time, most agencies, particularly at the state and local levels, must labor under inflexible, often archaic personnel policies and practices and non-competitive salary levels which do not permit them to employ, or in many cases, even compete for, either the numbers or skills necessary to solve their problems.

In effect, then, government agencies are caught in between a growing and increasingly complex workload on the one hand, and a lack of in-house capability on the other. Where is government to turn? Basically, there are two options--consulting firms and the academic community. There is no question that consulting firms have played and will continue to play an important and necessary role in government problem solving, particularly in the engineering and technological areas. But in my view, they have not yet proven very effective in dealing with environmental and related problems. And considering the rate at which new "environmental" firms are springing out of the woodwork, I don't look for much overall improvement in quality. Finally, in spite of the growth of "environmental" consulting firms, I don't believe there will ever be enough of them to meet all of the problem-solving needs of government.

What about academe?

There are a number of reasons why government should expect to be able to call on the academic community for help and why the academic community should respond. First, of course (if you believe their notices), the academic community is where all the answers are, the primary repository of knowledge and wisdom, where the state of the art is developing and most advanced, and where creativity and imagination flourish. At the very least, colleges and universities represent a vast storehouse of warm, reasonably literate bodies--a commodity most prized by government.

Also, notwithstanding their questionable performance, most colleges and universities, and particularly the publicly funded ones, espouse with varying degrees of enthusiasm, some commitment to a public service role--noblesse oblige.

Finally, I would point to a reason which would seem to be of increasingly eminent importance and practicality to the academic community--the vast reservoirs of government and foundation funds which have encouraged and supported basic research so handsomely for lo these many years are drying up. Much of the action (and the money) is shifting to federal, state and even local governmental agencies (with the advent of revenue sharing and the like), and they are looking for problem-solving help much more than research.

So, here we are, understaffed agencies with growing problems and money to spend, and a public-spirited academic community loaded with lots of smart people looking for support. So why don't they get together and live happily ever after? Let me highlight some of the reasons why government and academe haven't been able to click very well in a problem-solving context in the past and why, unless both change some of their policies, practices, perceptions, and biases, they won't. And, remember, I'll be generalizing here quite a bit.

First, let's take a quick look at the world of the governmental agency to try to understand something of the context in which problems are defined and must be solved.

Most important, governmental agencies operate in and must be responsive to the demands of the "real world" in which public policies are made and programs accomplished. This world is a world of pressures, problems, crises, unreasonable and arbitrary deadlines, and political realities; and more than anything else, it is a "today" world, where the rewards go to those who are able to deal with (not necessarily solve) today's problems today. This is not to say that government is unconcerned about tomorrow and the next day; but faced with the growing workload and people shortages discussed earlier, these short term, immediate requirements necessarily require a predominant and increasing share of government's attention and efforts. And, I think it is extremely important to understand that governmental agencies will not deal with long term considerations effectively (if at all) until they are able to get on top of their workload.

It is primarily in terms of getting on top of the today workload that agencies need and are seeking help most desperately. What they need most are people who are willing to pitch in and work with agency personnel in getting the job done. In many cases, they want someone to do the work for them, and it's often not pleasant or intellectually stimulating work. For the most part, the nature of the problems in environmental and related areas requires interdisciplinary efforts aimed at the timely, creative, imaginative and even intuitive translation of the vast amounts of unused existing knowledge into problem solutions. Not perfect solutions for the ages, mind you, but solutions designed to meet today's needs. And the services and products emanating from these efforts are expected to be designed and developed with the needs, capabilities and limitations of the ultimate user in mind. And they should be both useful and usable--immediately. Finally, agencies are looking for helpers who will stick around for the long haul.

Now, let's take a look at how the world of academe stacks up in terms of meeting these needs. Let's look first at the people--the academics--and then at the academic system or bureaucracy.

Traditionally, academics have avoided the real world and its problems like the proverbial plague, viewing the solution of day-to-day problems as someone else's turf and welcome to it. Many academics also seem to share a condescending stereotype of government personnel, viewing them as not-too-bright, often lazy, apathetic, or paranoid plodders, feeding at the public trough marking time to retirement.

As a result, when academics do work for government, they prefer to define problems in and on their own terms. In this regard, academics often try to make the real world conform to the world as they would like it to be--where all variables are clearly defined and are controlled or controllable and where decisions are made in explicit, objective terms. They then retreat to the ivory tower to produce products which seem aimed more at reaping academic rewards than at meeting the needs of those paying the bills.

And, once a product is produced, academics generally tend to lose interest and are inclined to leave the agency to its own devices in figuring out what to do with it.

Universities and most of the denizens who dwell therein are also highly specialized and compartmentalized into tight and relatively narrow disciplines and specialities, a situation not consistent with a problem orientation or conducive to an interdisciplinary approach. In this regard, most academic efforts at interdisciplinary activity that I have observed have been singularly uninspiring, or characterized mostly by lip service.

Another characteristic of academics is that they are usually not very interested in or even adept at the application or translation (creative or otherwise) of existing knowledge into usable forms, at lease not if there are new frontiers to be explored. Closely related, they are extremely chary about sticking out their respectable academic necks and making judgements or recommendations unsupported by hard evidence and extensive documentation which must be collected and prepared over long periods of time.

Many of these individual characteristics and attitudes owe their existence to or at least are perpetuated by the academic system or bureaucracy, next to which government at all or any level pales by comparison in terms of red-tape, rigidity, ponderous, slow-moving machinery, parochialism, and all of the other bureaucratic maladies. This formidable system appears to exist for no other purpose than to nurture and protect the rank, tenure, perquisites and egos of its members; and it, above anything else, sets the performance standards and rewards and punishments for academicians. To say that this system is not tuned into real world problem-solving requirements is the grossest of understatements.

What all of this adds up to, then, is that while the academic community may, in principle, be a logical source of help, academics and the system or real world in which they operate are not particularly well-suited or inclined to meet the immediate problem-solving needs of the real real world.

It is encouraging to note, however, that in spite of these formidable obstacles, one finds a growing number of people and efforts in academe committed to helping governments solve their problems. But in spite of strong commitments and good intentions, many of these have failed or have resulted in less than satisfactory results. And, in this regard, I want to pose two simple tests for evaluating success--first, is the end product of the effort used; and/or second, do any governmental policies or more important, practices, change as a result of what is done or produced.

Frankly, I think these tests are seldom applied. As noted earlier, the traditional criterion of effectiveness in academe seems to be to produce something--period. Unfortunately, I think many academics who sincerely want to help are still using that test, or none at all, assuming that the product will be used or change will result from it. Not so! Rather, the result is often frustration on one or both sides.

What are some of the reasons why products don't get used or nothing changes? To find out, let's examine the problem-solving context at a slightly finer grain.

--Although most agencies need help, they often don't know, or can't articulate clearly what they need. And, unfortunately, they often expect academics or consultants to know--which more often than not isn't the case (although as noted earlier, academics and the consultants often think they know). As a result, problem-solving efforts often focus on symptoms, and the wrong ones at that, which doesn't solve, or further exacerbates the problem.

--Agencies often expect too much from the academic community, assuming they can deliver the "quick-fix" to problems in no time at all. When agencies don't get the hoped-for, miraculous results expected, they become frustrated.

--Many important agency constraints to effective problem-solving are self-imposed, and often they have become so ingrained in policy and practice that the agencies don't even realize it.

These, of course, tend to get in the way of effective problem definition or solution.

--Although agencies ask for help, for a number of reasons they often don't really want it. They do want academics working on problems (so they can publicize it) and they do want products (which they can point to with pride), but somehow they don't always get around to using them, or at best, go through the motions; and very little changes as a result. One analyst of the bureaucratic scene calls this approach "dynamic inaction".

--Just as academics have stereotypes, so do bureaucrats. Academics are viewed by many as fuzzy headed, ivory tower know-it-all's, who are naive about, and have nothing to contribute to the solution of real world problems. At another level, academics may be feared or resented for their expertise, for the potential changes and disruptions they bring with them, and for their tendencies to identify deficiencies in the existing order of things. And these stereotypes are often confirmed when overly eager academics come on like gang-busters ignoring what agency people think and what they have done to solve the problem.

Many more factors could be cited, but I think they all represent pieces of a larger cloth which must be viewed as a whole.

I mentioned earlier the academic "system" which is so important in determining academic behavior. It is important to recognize that all organizations function in such systems and governmental agencies are no exception.

For each agency, the system is comprised of a complex web of dynamically interacting and continuously evolving laws, regulations, formal and informal customs, attitudes, values, roles, relationships, habits, and a host of other factors. And the system goes beyond the organization itself, encompassing other agencies, legislative bodies, the public and all of the other institutions, organizations and individuals which influence or are influenced by the agency. As in academe, this system establishes the formal and informal, real and imagined rewards and punishments which are largely determinant of what the organization and individuals within it will or won't, can or can't, do.

In my view, it is the failure by most academics to understand this system, or worse, to even recognize that it exists, that is the cause of most of the failures and frustrations in problem-solving efforts. This is because problems and symptoms cannot be clearly and accurately defined or differentiated; usable and useful products and services can't be produced, and in any case won't be used or lead to productive change unless the entire process is conducted with a sensitivity to and understanding of the requirements and limitations of the system.

What all of this means to me is that good intentions and sincere efforts are not enough to guarantee success. Wishing won't make it so. This brings me to the last of the questions I raised earlier, and the subject of this session: How can the academic community help government with its problems?

Clearly, many changes will have to take place on both sides regarding the policies, practices, perceptions, and biases I discussed earlier. This won't be easy, and it obviously won't happen overnight. But nothing will happen until universities truly want to help and are willing to give that help, initially at least, in terms of the real world requirements discussed earlier. And, I am convinced that if the initial help is successful in terms of the two basic criteria I mentioned earlier, the unreasonable and arbitrary characteristics and requirements of the real world will begin to change, and agencies and the academic community can get on with the business of solving longer term problems.

In closing, I want to propose, briefly, a few specific prerequisites for establishing and nurturing effective academic-governmental working relationships in a problem-solving context, and cite some examples from the university-agency program in which I'm currently involved.

First, it is important to recognize that a true working relationship is one based on mutual understanding and trust and that such a relationship can only evolve from open and honest communication. Now clearly, communication doesn't just happen--it takes time, effort, and real determination from both sides; and it is often frustrating, but there is absolutely no substitute for it.

Let me suggest briefly how we are going about establishing such a relationship in a program which is just getting underway between the University of Massachusetts and the Massachusetts Department of Public Works (DPW)--the state transportation agency.

Basically, the DPW has hired the University to assist in the development and implementation of a new statewide transportation planning process and in improving the quality and timeliness of its impact assessment activities. About 50 faculty, staff, and students are currently involved in the program; but if we are effective, the program should expand considerably. In essence, our role is to work as agency staff with a mandate to apply in whatever we do, the latest state-of-the-art developments as innovatively and imaginatively as possible. The only real constraint imposed thus far is that the policies and practices developed should be workable in the Massachusetts setting.

In terms of establishing a sound base for developing understanding and trust, we have developed a number of approaches, two of which I would like to share with you.

First, we are emphasizing close, continuing contacts between agency and University personnel in all aspects of our work. In this regard, DPW has appointed agency liaison persons for each of our major task areas specifying that *at least* 20% of their time should be allocated to coordination with University staff, either at the agency offices or at the University. The responsibilities of these liaison persons is to assist throughout the program in defining problems and needs, to participate in the work to the extent possible (it is their work after all) and to exercise continuing oversight to assure we are continuously going in the right direction. We have also stressed the importance of University program staff spending considerable time in the agency offices talking to and working with agency staff members. In this regard, desks and other support services have been provided in the agency offices for our people.

At the program management level, University and agency program managers meet *at least* once a week to discuss progress, so that any problems and issues can be defined and resolved early.

Another important communication tool we are using with success is a systematic, dynamic programming and work planning process. This process requires, *before* any actual problem solving activities get underway, the development of a detailed work plan for each major task area which includes the following information:

OVERALL PROBLEMS AND NEEDS - The Big Picture

--The overall goal(s) of the agency with respect to the task, with an emphasis on what *changes* in policy or practice are they trying to achieve in the long run.

--What steps are necessary to achieve the goal(s)--what actions need to be taken?

--What has the agency done thus far, or what is it doing to achieve the goal(s) and what effect has this action had?

--What are major constraints to achieving the goal, what are their effects, and how can they be overcome?

PROGRAM YEAR WORK PLAN

--Based on the above, what steps are proposed for the program year, and what is their projected impact in terms of overall goal achievement?

--What specific program activities will be undertaken during the year?

--What *user package* will be produced as a result of these activities? This includes a definition of interim and final products and when they will be produced in the context of an explicit definition of who the users will be and what their specific needs are.

--How and by whom will the user package be implemented to contribute to goal achievement--this, in effect, is the user package implementation strategy--where goals, actions, and outputs must be clearly related.

--What people and resources will be involved--personnel and budget information is broken down by quarters, including faculty/student time commitments.

It is important to recognize that the process is continuous in that all aspects of problem definition and program activities are being continuously evaluated by both DPW and the University in terms of new information and unforeseen developments.

I don't want to imply that the system is perfect yet. Far from it. In fact, it has been an extremely frustrating experience for everyone involved--mostly, I think, because neither agency personnel nor academics have traditionally been forced to document problems, needs and plans in such detail. In fact, our initial contract with the DPW is extremely general and vague, not unlike most contracts of its kind.

But what I would emphasize is that the process has had significant results in clarifying extremely important differences in assumptions regarding virtually every aspect of what we are doing, why, how, and who's doing it. In fact, we found that although we were using the same words and the like in our early discussions, we didn't truly understand each other at all, and that a variety of important people in DPW itself had very different ideas about what we should do, how, when, and the rest.

Based on this experience, I think I can say unequivocally that without such a process, we would not have recognized these important misunderstandings until well into the contract year, and might never have clearly understood what the problem was.

In effect, then, I think we are well on our way to establishing a sound and productive working relationship between the University and DPW. In my view, both the agency and the University will benefit greatly from this relationship, and in the process, hopefully, so will the people of Massachusetts.

Finally, I would emphasize that we haven't done any magic tricks here, or that our way is the only way. Surely, we're not the only ones to have established good working relationships between universities and governmental agencies. But I would re-emphasize that such relationships cannot happen unless the conditions I discussed earlier are met.

THE ROLE OF UNIVERSITIES AS A SCIENCE RESOURCE TO GOVERNMENT AGENCIES

James M. Witt

The most important scientific resource in the nation available to serve the public interest is in the universities, and it is being under-utilized. By scientific resource I mean a reservoir or group of people who understand and use scientific principles and have a familiarity with the current state of knowledge of a particular subject, but I do not mean a reservoir of persons capable of finding the best solution to a broad problem to be implemented within an existing economic and technical societal structure. This is because the "best" solution to a problem is often subjective, depending on one's interests; and universities are not well equipped to divine the limits of socially acceptable solutions to complex problems. Within these limits, let us consider the relationships of the university based on scientific resource to the functioning of government--local, state and federal agencies and the executive and legislative branches.

Both previous speakers have been critical of university inputs to government in relation to environmental problems and have generally characterized their overall efforts as failures. Perhaps this characterization is derived from specific observation of failures, or perhaps it is derived from an inadequate perception of the sort of input which can be reasonably expected from a university. If we cannot agree on whether universities have failed, I am sure that we can agree that their resources can be better utilized. If universities are an under-used resource, there are several reasons for this--some lodged within the universities and some within the agencies. Let us examine the characteristics of these groups which affect their working relationships.

With regard to the kinds of things that universities do for public agencies, we are research oriented. This is,after all, why agencies come to us, to identify the knowledge we have gained through research activities. However, the successful solution to a research problem requires that it be a fairly well-defined or narrow problem conducted in an isolated environment where the variables can be

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identified and controlled. This is why we bring experiments into the laboratory, and in doing this so simplify the system that it may not be representative of what has been called several times today "the real world". When we carry out field experiments, we carefully choose a manageable system in which we believe the important variables are constant or are at least quantifiable. Results from field experiments, which are the record phase in experimental sequence, are more difficult to interpret than those from laboratories, more difficult to reproduce, more expensive, and must be repeated many more times. Quite often this phase is not carried out adequately because of lack of funds, personnel, time and other reasons.

The third phase is where we interact with agencies. When we attempt to solve societal or environmental problems, we are faced with a whole host of uncontrollable and even unidentified variables, and there is a question of whether prior research pertains. But that is all we or anyone has to go on, unless you care to rely on divine inspiration, "experience", or belief in what you hope and want to be true. (By experience, I mean a series of events in which an observer participated but no quantifiable measurements were taken.) The problem then becomes one of communication between the agency, the legislator, or the public and the researcher. Predictions of effects consequent to a particular course of action can be made, but they must be qualified according to the degree of uncertainty surrounding important uncontrolled variables.

Not only are projections from past laboratory and field experiments variable, but their application to predict the outcome of situations in the real world is dependent upon knowing in advance the range of values to be expected in the host of uncontrolled environmental variables which affect the outcome. Since this can involve things like predicting the weather a year in advance, population or parasite levels and flux, exposure levels, and so forth, we are faced with a double dose of uncertainty on which to base our forecasts. The problem is then that the user of research information wants a simple yes or no to a problem which is not simple, and because of his training, is not able to deal adequately with the principles of uncertainty, while the supplier of research information must endlessly qualify predictions, and seems equally unable to deal with the fact that many social decisions cannot be a maybe, but must be a yes or no, go or no go, and you cannot qualify a yes or a no.

The nature and character of the people involved are also factors affecting university-government relationships. Many kinds of jobs tend to be self-selective for certain types of individuals. Research workers generally are rather independent. This is much more evident at universities than in government agencies or commercial corporations. Research work at universities tends to be selective for the individual who says, "I am going to work for the university because I can do what I want, because they have freedom of research there." Of course, we don't really have complete freedom of research at a university in the sense of being able to do anything you want--unless you are wealthy enough to finance your own research. We do have the freedom to go out and convince people, agencies, foundations or companies to give us enough money to do something we would like. Within this limit, we are generally free to choose our own research activities. Administrators, either administrators within universities or administrators in state or federal agencies, simply do not order university faculty to work on a particular problem. They may make funding available or withhold it, they may persuade, cajole or argue, but they do not order. This is in contrast to how it works in government agencies, where administrators may move large numbers of people from one project to another, start projects, stop projects, or spay projects.

A related characteristic of universities is that all the significant portions of faculty research time are committed far in advance, usually for three to five years. The reason for this is that a very large proportion of faculty research is funded by grants from various federal agencies or from foundations which typically fund a research program in three to five year cycles. The process of conception of a research program, development of procedures, preparation of proposals, reaction time to proposals, award, inception of work, assembly of staff and materials, and getting the program up to speed seldom involves less than two years. You can see that universities work on a different time scale than agencies. Agencies usually want a quick answer about a specific problem on which action must be taken tomorrow or the day after, while universities study a problem thoroughly and are therefore on a longer time scale with a slower reaction time. Whether this is good or bad depends on what you want, but that's the way it is, and it affects profoundly the relationship between governments and universities. If an agency tries to use a university for something which it was not designed to do, that agency is doomed to disappointment because of inappropriate expectations. Many of us feel that there is an important social need to change this mode, for universities to become somewhat more mission oriented, but this will not happen by wishing it were so or by complaining. It will happen through deliberate problem analysis and a well thought out change in the funding and the relationship of universities with agencies and legislatures.

There is another mode in which the university can offer a quick response which the agencies often find pleasing. When the problem facing the agency fits into an ongoing research activity, university scientists are often able to fit a few additional tests, which may provide the answer to a specific problem, into their research program without a serious dislocation of effort or jeopardizing the continued support of their research by the funding group because of failure to meet their objectives. When this is the case, an adequate answer can often be provided rapidly. Sometimes the agency needs can be met without conducting new research, but merely by assembling and interpreting appropriate information from the scientific literature.

Of course, this is an activity that agency personnel ought to be able to do as well and as quickly as university scientists, if they are operating in a field in which they are knowledgeable and have kept up-to-date. Depending on the nature of the request for assistance and the degree to which it is congruent with recent activities, a request which requires only a literature search may utilize a single man-day or several man-months of effort. It is never something that can be tossed off between classes, so to speak. It is important that state agencies understand this--that, as in the real world, "you gets what you pays for", because universities are also a part of the real world. It must be understood that, except in unusual circumstances, a commitment of university faculty time requires the same care in planning, problem definition, product definition, identification of resources, allocation of funds, and acceptability of institutional arrangements as is normally done with any other contractor--commercial or institutional. If we are to talk about failures of universities in providing help to government agencies on environmental problems, let us distinguish between those efforts which were properly planned and those which were casual or "something for nothing" requests.

A fourth type of problem encountered as a part of the character of universities is that research is usually a monodisciplinary activity, while environmental problems are multidisciplinary in nature. This means that scientists must work as a group, sometimes accepting directions with regard to their research from colleagues or administrators. This voluntary surrender of independence can only be when the individual is convinced that the problem is important, the proposed program is meritorious and intrinsically scientifically sound, and that substantially more progress will be made if it is a group effort. This is not an easy thing to accomplish and we at the Oregon State University Environmental Health Sciences Center devote a great deal of time to help bring this about within just one small group of the university.

Another important characteristic is that professors are people who, like all others, respond to reward; and there are few, if any, rewards for ad hoc public service within the university system. Promotion and tenure within the universities are often described as being a function of excellence in one of four areas: teaching, research, public service, and university service. The fact is that for most faculty members in most universities, promotion is granted for excellence in only one of these activities: research--excellence in the kind of research that results in publication in referred journals. Although administrators like to see activity in all four areas, when the crunch comes they count your publication record, not how much service you gave or how many reports you prepared for government agencies Until this is changed, how, in all fairness, can you expect a faculty member to take time away from his publishable research activities merely to help solve a real problem? If you want more and better help from universities, don't attack the professor, change the system.

A sixth characteristic of universities is that their research programs are heavily oriented to federal interests, not to state interests. The reason for this is that even though states build the universities, staff them, and pay for them, they provide very little in the way of continuing research funds. This statement will immediately provoke loud screams from legislators who will point to the research funds they do provide. While I have no wish to offend any legislators, I do suggest that they compare the spendable state research funds to the spendable federal research funds at any state university. The state funds are usually a mere pittance, highly directed, short term, and getting smaller every year. The result of state governments' spending a lot of money building a university and a faculty and only a little on their research activities is that the faculty is under constant pressure to "get a grant", so that they can carry out research activities. The principle sources of grant funds are federal agencies and national foundations.

Although faculty members will constantly try to adapt local problems to the scope of national funding, they could be a lot more successful if they were adapting it to state funding. One result is that research work related to a state problem is often done in some other state, and the local agencies have difficulty adapting the implications to their conditions. This is the case in one of the examples given by the previous speaker as a failure on the part of universities to respond to a need. The problem of re-entry by farm workers into fields treated with pesticides has been inadequately studied, and nearly all the earlier studies have been in California or Mississippi, with one study done in the state of Washington. It was stated that a response to the need for re-entry data was not available from the universities, but came from a laboratory maintained by a state health department in a small town in Washington. A word of clarification might be helpful. The laboratory in Wenatchee which did some early re-entry work is not just some small lab in a small town. This is a laboratory of national importance founded more than 20 years ago by the U.S. Public Health Service and now under the Environmental Protection Agency. The fact that it is in a small town is no more important than that Washington State University is in an even smaller town. There is a state health department laboratory in Wenatchee which studies related human effects also, but this state lab was also founded and funded by the USPHS and now by the EPA, even though it is administered by the state.

More recently, a research project on re-entry was begun at Washington State University. This was possible because a very able scientist at WSU was successful in competing for federal research funds for this purpose. Notice that all of this is from federal funds, not a penny of state funds. All of this notwithstanding, state university faculty and state agencies made notable contributions to bringing some sense to the questionable regulations on re-entry proposed by the Department of Labor through correspondence, meetings, and at public hearings. This activity seems to have escaped notice. I should also say that universities and state agencies and federal agencies did not give the question of re-entry hazards adequate research investigation until the issue became politicized. This was because it seemed to them to be a non-problem, and they failed to recognize that the importance of demonstrating safety, if that is the case, is equal to that of demonstrating hazard if that be the case.

The problem of 2, 4-D given by the earlier speaker as an example of successful university assistance to a state agency is also related to funding. State funds in Washington became available when an economic interest was threatened. 2, 4-D damage appeared on grapes in Washington, and wheat growers use large amounts of 2, 4-D in places and at times that might cause this damage. The faculty at Washington State University did what they could at all times, but did a lot more when funding was available. However, I cannot characterize this as a success or a "bright star", but must say that in my opinion the problem solving associated with the 2, 4-D/wheat problems in Washington and Oregon has been an example of a failure in cooperation, collaboration, and planning.

The problem did not begin a couple of years ago in Washington as indicated, it began nearly fifteen years ago in Oregon. Attempts to solve the problem on a bi-state basis failed, so Oregon solved her vegetable and ornamentals problem alone by banning volatile 2, 4-D formulations in certain Oregon counties while Washington did nothing. Then the grape industry expanded in Washington, and they were recently confronted with more or less the same problem. It would take too long to go through all the case study details, but suffice it to say that they concluded that the 2, 4-D was coming from 50 miles away in Oregon rather than from closer fields in Washington, and that the agency and faculty people in Oregon resisted this conclusion. If we look at the whole fifteen year history of this problem, I think we can agree that university-agency, and particularly the interstate cooperation has been a failure that might have been avoided if both states could have provided appropriate mechanisms of continuing research support, problem identification, and review.

The seventh and last point about the characteristics of a university which affect how it can help an agency has to do with the competence of individuals. This can be a very delicate and touchy subject. We like to think that university faculties contain only competent people. I hope that this is true, and let's assume that it is. However, the problem comes about because, if each of us is competent, we are sufficiently competent to be called experts only within a certain specialized area. Sometimes we are called upon to make judgments outside that area, and when we do it is incumbent upon both the faculty member and the audience (be it an agency or the public) to know that he is outside his field of expertise. When one is outside his field of expertise, his information may be very useful, accurate, intelligently knit together, and comprehensive, but it must be examined with more care than when one is in his field. In other words: if I am in my field, listen to me; if I am out of my field, listen to my arguments. This is a good place to clarify that today I am out of my field. I am a chemist, a biochemist, a toxicologist and maybe an entomologist, but I am not an expert in university-government relations. I have had several years' experience in a number of ways in working with agencies to solve scientific problems of interest to the public, and I hope what I have to say is of merit and interest, but I have not formally studied the process in a disciplined way, so I am not an expert in the subject of university-government relations.

When a university professor is speaking out on a public issue he may be speaking as an expert, as a disciplined scientist who is well informed on the subject, or merely as an interested citizen. It is well to know which category a scientist is in as you listen to his testimony; so that you will know how to listen to him. It does not necessarily make him wrong if he is in the second or third category, or right if he is in the first, but you listen differently. I think there were some problems in this area which caused the previous speaker to make the comment that "university professors blew it when they predicted that DDT wouldn't kill the tussock moth and, in fact, it did and it ruined their credibility". There were some people, not necessarily university professors, who were outside their field and saying something like what was quoted, but we also have the problem that agency people weren't listening very well. What was being said was not that DDT would not kill the tussock moth, but rather that, in spite of there having been several large, operational control programs since 1947 with DDT, these measurements of kill were generally qualitative (e.g., all killed, none seen, etc.) rather than quantitative (i.e., careful counts of survivors per 1,000 inches of branch surface, or percent mortality) measurements which could be compared with recent studies on sevin, dylox, zectran, BT, or other pesticides so that the adequacy of each could be compared on the same basis.

Then too, the terms "kill the moth" and "effectively control the problem" were sometimes used interchangeably by scientists in universities, agencies, and the public. The two phrases mean quite different things. The first should be clear enough, but the latter means to save trees--it does not mean to kill moth larvae, or to save the foliage or needles on the trees, but to save timber. This involves forecasting based on a great many variables including the kill of larvae, the natural decline of the population, the vigor of the trees, the ensuing climatic situation, the recovery rate of injured trees, the decline rate of injured trees, secondary infestation of apparently saved trees, and so forth. It takes about five years after treatment to find out how much timber you actually saved. This has not been done very often, and forecasting (the claims that DDT would save all the trees and those that it would not save any) was done from a very thin data base. The information transfer between research and management and to the public by the media was the worst I have ever seen and there was constant confusion between tree loss and infestation, and between saving foliage and saving trees. This is what gives rise to statements that over 800,000 acres of trees were lost or injured or killed because we couldn't use DDT. Although it is hard to sort through the data on a proper basis for a variety of reasons, I believe the actual loss of timber to the moth, even including areas that would not have been treated had DDT been freely available, is equivalent to about ten percent of the acreage quoted. That is not a small matter, but it is not 800,000 acres.

The tussock moth problem is a good case study of use of scientific information in the solution of technical problems about which there is a variety of partisan interests. It is my opinion that by and large this was not handled very well. I would defend the efforts made by the universities to assist in the problem (although the amount of effort was quite variable between them), but the failure occurred because of a too rigid information transfer system. Information between organizations generally had to go up to the top, over to the next organization and then down to the people who use the information. Information flow seems to work best when it is direct between scientists and their management or agency counterparts, and when it can be developed over a sufficient period of time so that they can learn to understand and trust one another. You have to learn who to work with and how to work with them and when or under what circumstances. This takes a great deal of time, special effort, close contact, understanding, and patience on the part of all parties.

We have listed seven characteristics of universities and their faculties that affect their ability to help or supplement government agencies in their work. These were that they (1) are research oriented, (2) have a high degree of independence, (3) are committed for their time far in advance, (4) tend to be monodisciplinary in their work, (5) are under a reward system that does not encourage response, (6) need to be funded to do an adequate job, and (7) are specialized in their competence and the right people must be identified. Perhaps an eighth should be added. Universities do not speak with one voice. Agency people often ask whether you represent university policy. Universities have policies on administrative matters, but they do not and never will have a policy on a scientific issue; and no one can speak for a university, as such, on a scientific issue. A person from a university can speak for himself, or even a slightly larger group that has reached a consensus, on a scientific issue--but not for the whole university. Government agencies sometimes have policy positions on scientific issues, particularly in regulatory agencies, and this sometimes causes confusion between the two.

Some of the characteristics of government agencies which I perceive to affect the problem of the use of universities as a resource have been mentioned along with the discussion of university characteristics. Other characteristics deserve special consideration. The agencies have different objectives and responsibilities than the university. They are usually a regulatory body, and universities tend to stay away from regulation as much as possible. We stay away from regulation because we don't have the authority, and because many of us also work regularly with those segments of the public that are subject to regulation. In order to work with these people, we must have their trust and confidence. This need not be a large problem, but it can be an inhibition at times.

Government agencies have the responsibility to see that business is possible. I think that is what is sometimes meant by "the real world". They enforce their regulations, keep adversaries apart, move activities along in a certain direction, but they also have a responsibility to keep the wheels running and to keep the motion orderly. I think that this unstated responsibility to see that business is possible weighs more heavily on agencies than on university scientists, sometimes affects their decisions, and sometimes keeps us apart. Maybe lack of recognition of this is what the previous speaker had in mind when he cautioned university professors not to get "too beady-eyed". I love that phrase, "too beady-eyed". It is true that one can, and frequently does, compromise his credibility by becoming an advocate rather than an advisor, and by finally becoming a missionary or zealot. This helps to draw attention to a problem, but seldom helps in finding a socially acceptable solution. I would only ask that we be as quick to identify the "beady-eyed" syndrome when it occurs in the business community as when it occurs in the academic community.

Another problem is that of domain or the territorial imperative. This is somewhat difficult to discuss, but we would be incomplete to omit it. You see people jealously guarding their domain all the time. Agency people don't often come into the university and tell us how to teach our course, or arrange our curriculum. If they did we would probably split them from their crotch to their eyebrows. However, it is not unusual for us to do something similar--to drop in and tell them how they ought to be regulating some problem, or running their agency. This can tend to keep us apart. Agencies will listen to our advice when they have asked for it, or when we are serving on an advisory committee. This is a carefully limited role. The advice can be accepted or rejected. It frequently is rejected, and of course we are upset when it is. Agencies don't like to be asking universities for answers to every little scientific problem that comes along, or it would look like they didn't know their jobs. The problem cuts both ways, but there is a problem of guardianship of roles that tends to keep some distance between us in regard to how involved we are going to get in helping each other solve problems.

A fourth problem is that agencies usually have difficulty in accepting disagreement. This is not unique to government agencies--I personally have the same problem. When a person or an agency comes to you for advice, they usually don't want advice at all. They want confirmation that what they already planned to do is okay. Usually they are just touching all the bases and very seldom do you find a true case of "I don't know what to do. If you have information on this, and can tell me what to do, I will do it." Most often the direction to go has already been chosen, and if you want to change it you must be very tactful, and subtle, and patient. We tend to be so nice and use euphemisms like, "Here are some viable alternatives. Have you considered this?" and so forth, sometimes to the extent that we don't get our point across. Then we sometimes get a little beady-eyed. This is a human problem, not specifically an agency problem. However, if you ask for input to assist in solving a problem, be prepared to listen and consider very carefully, even if you don't like the answers you are getting.

The problem of competence affects agencies just as it does universities. We can start by assuming that a man is competent in his job, but we must also ask whether his area of competence extends to include the particular issue at hand. This can be a very difficult area when we are trying to apply complex and contradictory research information which is at the edge of our knowledge and usually incomplete to a practical problem that needs a solution now. The ability of an agency to respond in this situation can be quite different depending on which agency we are talking about and at which level of government it is. Generally, federal agencies have a number of people with good expertise in handling research information and drawing conclusions from it, state agencies are not so well staffed in this regard, and local agencies are usually devoid of persons with such expertise. The importance of research experience in making decisions resting on information at the forefront of our knowledge was touched upon earlier and can be summed up by saying that the research scientist will be more sensitive to the hidden assumptions, qualifying conditions, and uncertainty principles than the scientist who has worked largely from protocols.

The legislatures are a special branch of government that we also relate to in the same general way as we do with agencies. Legislatures tend to balance the tug-and-haul of various interests which are interested more in serving themselves than the common good. Balancing this tug-and-haul is the art of applied social science, commonly known as politics, and the physical or biological scientist is frustrated because he is insensitive or indifferent to the fact that the social structure can provide limits to the solution to a problem which are just as real as physical laws or biological order. The legislator often retreats from conflicting scientific testimony with the comment, "How can you expect me to decide, when the experts disagree?" This betrays a lack of understanding about the scientific method. Science is always right....eventually. But "eventually" can be a long time coming. Science is right because its method is to pose hypotheses which can be tested through discrete measurements. These measurements are published, subject to scrutiny, re-analysis and re-testing. Along the way there can be much disagreement, and any conclusion can be changed later when some totally new experiments shed new light and make new interpretations of old experiments possible. In the meantime, legislators and agencies have to make decisions with inadequate information in the face of uncertainty and disagreement. If they must do this in areas subject to testing by scientific methods (not all areas of inquiry can be so tested), they would do well to gain some modicum of skill at detecting when data are incomplete or poorly handled, when a hypothesis is well supported and when it is not. If they do not wish to do this, then they must have a great deal of skill at identifying who is capable and who is not, who to believe and who to disbelieve.

This discussion has been cast in terms of how universities can relate to government agencies, and some of the problems affecting this relationship. A more general setting for the problem would have been to cast it in terms of research versus management. Nearly all of the problems we have been discussing occur in any relationship that I know of between research scientists and management scientists. The research versus management problem is indigenous to any organization which contains both elements whether it be a state or federal agency or a commercial enterprise such as du Pont, and it is principally a problem in communication through, over, and around organizational structures and capacity to communicate in spite of disciplinary differences. If we perceive the problem in these terms--the research versus management terms--rather than in terms of a university-state agency problem, it may help in the solution.

The solution to the problem of the under-utilization of universities as a scientific resource base by government agencies in coping with environmental problems is not evident and evidently not simple. We can be certain universities will not be making a greater input than now if we just complain a little and then drift along as we are doing now. All sides to this problem, agency people and university people alike, must deliberately seek and implement a solution just as they do for any other problem, or else we must conclude that they really do not give a damn.

Fundamental to any changes is a willingness to change, a willingness to work. Let's have a willingness on the part of the state agencies to come to the universities for help on their problems, and a willingness on the part of each and every faculty member to respond when the man comes in, to really help him. Don't tell him how you're carrying 14 class hours, how your research program is planned for three years in advance and you've got a class in five minutes. Either find a way to help him or find someone who can.

Agencies need to be willing to come to faculty more often with more kinds of problems, if only to get them familiar with your problems so that they can see opportunities to incorporate work on some aspects of your problems in their long range planning. This discussion could be in the form of an advisory committee (which tends to get stultified), a discussion group, or one-on-one, but it needs to be on a regular and continuing basis, not just formed when you want to legitimize something or need some help ducking a hot one. You have to take the initiative to form the group and start the discussion. In all of the examples of failures presented by the previous speaker, the common factor is that in not one case did a state agency ask the university for assistance on a specific aspect of the problem, while in the successful example, they did.

If faculty do not have enough time to devote to extracurricular problems, I have a possible solution which will strain your imagination. Do not give out any more of the nine or ten month appointments, but put everyone on twelve month appointments. Then challenge them to find a state or local problem in which they can effectively contribute to the solution. Give them as much promotion credit for this type of work as for published research work, in fact make successful participation mandatory to promotion. This will cost money, and the legislature will have to want it, so it probably is a pipe dream.

Provide adequate and continuing state research funds on somewhat the same basis as federal research funds. State agencies, the executive branch, and university scientists could partition the funds in a general way according to problem identification and state needs, and scientists could compete for them in the same way they do now for federal funds. This, too, would require a drastic change in the way the legislature sees its role and the university's role in public service.

Finally, I would advocate the formation of Governors' Science Advisory Councils in much the same way that we used to have a President's Science Advisory Council. The consultation between state government and universities needs to occur in many contexts, more often, and more regularly. This must occur not just among top administrators (which has the flaw of up-and-over communication), but also among scientists at all levels. If the latter method produces disorganization, it also produces understanding; and order can be achieved through coordination with the GSAC.

If we are willing to make the effort, we can find the solution to the problem of under-utilization of university resources. We all must make the effort, and, who knows, universities might even become a little more mission oriented.

DISCUSSION

Comment: I agree with a lot of things that Bledsoe had to say because I have a little bit of familiarity with one of the areas he was talking about, and that was the tussock moth infestation. But I had some real problems with some of his actual facts. There are various levels of damage that can take place. Class 1 damage is where 50 percent or more of the trees are completely defoliated. Class 2 and Class 3 show much less damage. A large percentage of the 800,000 acres mentioned was in a Class 3 area, so that by no means all of those trees were lost.

The second thing was the implication that, had the DDT been available for use in 1973, the tussock moth infestation would have been stopped. I take issue with that. Not because I dispute the effectiveness of DDT, but I do dispute the effectiveness of the Forest Service in finding out where the infestation would take place in 1973.

Let's assume that DDT use had been allowed in 1973. In the fall of 1972 the Forest Service was assuming that it would be. They surveyed egg masses throughout the forest in the fall of 1972 to find out where the little beast was going to be in 1973. Then they drew areas where they planned to spray DDT in 1973. They were not allowed to use the chemical. But we now have concluded that more than 50 percent of the Class 1 and 2 damage in 1973 took place outside those areas.

I've done some investigation in this area, and I'm speaking from my own published research on it. It's very important that we do educate, not indoctrinate, especially if education is to be a function not only of the university, but of environmentalists and state agencies as well.

Bledsoe: Your point is well taken. As a matter of fact, the areas of supposed contamination and the areas to be sprayed will probably be the subject of a debate that never will be resolved. It's interesting that in the areas allocated for spraying in this year's eradication attempt, about 140,000 acres were not sprayed because on-site observation said that the egg masses did not actually constitute a problem.

I would hope, however, that we don't get ourselves in a knee-jerk position so that anybody who says we've got to control this pest in the forest, cannot traffic with an "environmentalist", or on the other hand, that those who would

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Kai N. Lee of the University of Washington was the moderator for Session 15.

defend the biological routes for solution, which I think hold a lot of promise, do not at the same point insist that there will be no resorting to any kind of ugly chemicals in the interim until we can develop the techniques. Rather than spending our time trying to prove our point, whatever that might be, at the expense of somebody else, I would really be delighted to see some basic research done and see if we can't increase the fertility of the insect that eats tussock moth larvae. Or, there are some breakthroughs yet to be made, and I'm convinced that the answers are probably someplace in the potential of spraying with a virus rather than a chemical. I'd be delighted.

I don't think 1973 did credit to anybody, the government resolution process, the credibility of those who were asking for chemical release, the response of the EPA or the data bases being put forward all along the line. It was a classic story of a breakdown in communications between people holding dissimilar points of view. They probably could have agreed if they could have gotten together, but everybody was down at one end or the other of a long hall. There were no conversations, there were only shouts. It's hard to hear what the other guy is saying when you're shouting at the top of your lungs.

Secondly, there was also some rather unfortunate, and I hope not to be repeated, role playing. People froze in postures of advocacy or resistance to the use of this chemical. They were so badly equipped with blinders that they couldn't see that in the periphery of their vision there were probably some rational midpoints that could have been established.

We did not have a carbon copy replay of that in 1974. There are still some problems in the assessment of where we are for 1975. My guess is that any solution will be produced in a much less hysterical atmosphere, and with much more rational input. That's really what it's all about, isn't it? Coming up with some answers?

Question: I wanted to ask what you feel the role of the economic sector would be in trying to solve problems. Environmentalists now are trying to prove their credibility, because they've challenged the current way of doing things. Well, what role does the economic sector play in helping to solve these problems?

Bledsoe: I suppose that I would expect them to approach the problem as rationally on their side as they would hope to have the environmentalists approach it. In the case of orchard reentry by orchard crews, I would hope that rather than reach for carte blanche to do anything they want, that they recognize they're dealing with a human animal, and that the worker is entitled to return from work with his faculties intact. So as a result, the industry should not expect to place that worker in a physically unsafe situation. There should be some common sense, rather than a unilateral approach, again, that in the economic sector we've got all the answers -- just leave us alone and everything will be fine. The answer is, "That won't be."

Question: My question to those who know more than the average citizen, who is confused, is what do you expect from the citizen? What should the citizen respond to? He's got questions. He's been told that there's a major problem and that, as a responsible citizen, he needs to take some responsibility for solving that problem. So let's assume that he says, "Okay. I accept that responsibility." What does he do? Who's telling him what to do? Where does he get his information? And how does he make decisions between conflicting expert opinions? Or does he just say, "Oh, the hell with it. Nobody seems to know, and I'm told one thing today and the next day I'm told that's not right after all. I just plain don't have the time or the energy to figure out who's right, and I'm just going to go on doing what I've been doing, because that's what I can do most easily."

Answer: I don't think I've got an answer for you there, except maybe taking the time to study and learn it yourself. But that doesn't answer your question either, about which of the conflicting points of view should I believe, the guy from the university? He's supposed to be a professional, unbiased, and so on. Perhaps the fellow from industry. Or the fellow from the state agency. I don't think there's any such thing as an unbiased person, to tell you the truth. Somebody said that old scientists never change their minds, but eventually they die.

Comment: Speaking from a citizen's point of view, I've found it important to start working on sound methods whereby your government and your citizens can establish some meaningful communication, and some process whereby citizens can be involved in the planning processes early in the decision-making stages. Otherwise, I don't see any chance for resolving any of the idealistic or the necessary scientific ecological and environmental issues. There has to be that buildup of trust. We are showing government people how to deal with citizen input, how to deal with advocacy or deal with harassment, all the usual things that go on with input in this exchange. I think this is the only hope of getting things done.

Answer: When I say I don't know how the citizen can decide what to do, maybe this is compounded out of some helplessness and some hopelessness that's been growing over the years, but I'll give you one example. Suppose you were to try to answer the question for this group, does DDT cause thin eggshells or not. Now that's an important thing with regard to a whole sequence of social actions with regard to use of this chemical. You could listen to debate. You could look at the original literature. You could try to study this out for yourself. You could involve a lot of your time, more than you can spare. You could look at the weight of opinion. But you are going to be left with some people who have nice faces and are very credible saying that it does, and somebody else who's equally nice saying it doesn't. Now how do you decide?

Comment: There's a more fundamental question about citizens being confused, and that is that citizens operate in a social decision-making context where the issues and concerns are different from the issues and concerns that technical specialists and scientists are concerned with. In my view of what's wrong with the process now, I don't think we're going to be able to do away with the kinds of questions you bring up, but we need to put them in a different context. If I were you, I would be pressuring all I could to make planning and planning processes and impact assessment processes more responsible to the social questions that are really at the heart of these things rather than the technical, scientific questions which planners and scientists deal with.

The fact is that planners and the scientists in agencies have developed the process by which decisions are supposedly made, and they go through all these technical magic tricks. In transportation and water we do all kinds of modeling. We make all kinds of technical assumptions which never get shown to the public. Ultimately, you get all your information in one way or another from those processes. What I'm saying is that you have to make those processes respond to the questions that you want to ask, not the questions that the technical specialists want to answer.

In the Corps of Engineers we produced more paper that had absolutely nothing to do with the decision that was made. Why? Because all of that paper contained all kinds of information that, while it was relevant to the decision, wasn't in a form that the decision makers, including public people who can put pressure on decision making, could understand. So you have to do what you've been doing. You have to decide on whatever basis you want to decide on, and my feeling is that those processes can be made more responsive to the questions you ask. And that the technical specialists can be forced to put their own information, disagreement or not, more in the context of the question that you are asking, so that you are not just the citizen who is at the other end of this tube that's spewing out all of this useless information, being forced to try to deal with that system.

That system is there to serve you, the citizen. Why can't that system be made more responsive to the questions you're asking, rather than -- this is the question that citizens always ask, with this helpless feeling -- how can we become more responsive to you? Baloney! How can that system become more responsive to you? That's what you ought to be fighting for.

MEDIA INSTRUCTION FOR COMPREHENSIVE ENVIRONMENTAL EDUCATION

Martha Sager

The need to establish media communication with millions of people in the inexpensive, readily acceptable, and provocative media was recognized by educators with the coming of age of television documentaries. Utilizing the documentaries as teaching devices, courses for college credit were developed. Institutes for adult education became an accepted educational methodology through the medium of television. Short-range television was used in commercial schemes whereby department chains could educate their personnel in ways and means of filling out forms and so on. From the middle 60's, the United States began to feature such exotic courses as Russian at six o'clock in the morning and so on, through television. There are two words in that initial description, inexpensive and readily available, which are not really applicable to television even now, especially when we consider the millions of people in inner cities in the United States or in isolated rural areas. There, the cost of purchase of a new television set, coupled with the repairs which may be necessary later, is beyond the financial means of many families.

While all this was developing, radio had been long established as a worldwide communication medium, but radio had largely been ignored during this period of rapid development of television as an educational medium. Radio had been relegated to the area of advertising and soap boxes. But radio was less expensive than television; and by the time rock music came along, small transistor radios had become available, providing unusual mobility for the listener. This fluidity and low cost became of interest to persons looking for an inexpensive and readily available communication medium.

Simultaneously, the immediate need for environmental education burst on the American scene about 1970 with the passage of the National Environmental Policy Act, accompanied by the development of Earth Day, active citizen participation, and interested student groups. The federal government became responsible for the national environment; and wide public concern, interest, and action developed.

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The American University then began to explore the possibilities of comprehensive environmental education through the radio medium. Two programs were developed, planned, produced, participated in by citizens and university students, and have been evaluated. The first of these was a children's program called "Asphalt Ecology", which was structured for elementary school children in the District of Columbia Public School System. "Asphalt Ecology" used as its technique not only the lecturer or teacher, but included in the participation three children selected from different schools within the area who actually presented the information themselves, led the discussions, proposed questions to each other, and commented and related themselves back to the students who were participating in the experience in the classroom. "Asphalt Ecology" was accompanied by a lengthy teachers' manual and study guide to help the individual classroom teacher find and utilize the many materials available free from the federal government and from municipalities in order to interest the children in environmental matters.

"Asphalt Ecology" was quite successful; and although it started out to be a Cultural Enrichment Program in the District Public Schools, it became after the second year of its operation an integral part of the environmental education and science education programs at the elementary school levels.

Armed with this success, the same group in the Environmental Systems Management Program at the American University under the direction of Dr. Martha Sager decided to prepare for university groups, and also for adult citizen participation, a new across-the-board multidisciplinary comprehensive environmental education program entitled Ecology and the Human Environment. The program was specifically directed to interest people in the human relationships to the natural, technological, and sociological environments in which we have our lifestyle in 1974.

Ecology and the Human Environment made use of the radio medium again, an accessible and inexpensive device; coupled with this communications medium was a traditionally accepted academic methodology. Each student developed his own "Environmental Portfolio" through following a study guide which was prepared and related directly to the 28 lectures. The study guide contained a series of five questions which were identical, and the student answered these five same questions for each lecture. Because the lectures were broad, the student was asked to pick one item from a lecture and develop his portfolio around that one item. The portfolios were developed, then, based on the individual interest of the student, the professional expertise of the student, and reflected many differences in opinions, in attitudes, in understanding. Telephone and mail communications were part of this education methodology and were used extensively in counseling. Students mail in their completed portfolios after every seventh lecture. These are then critically analyzed and returned to the student for incorporation of the ideas into the rest of his portfolio.

The first three times the course was taught, there was a mid-semester examination and a final examination. Student evaluation and commentary were considered in an initial course restructuring, so that now the entire grade for the course is earned, by those students taking it for credit, on the nature and extensiveness of the portfolio developed.

Finally, a new radio series has just been completed by some group at the American University, and it is somewhat different from Ecology and the Human Environment because it is an attempt to do in-depth education through the radio medium. It is an effort to teach the elementary principles of environmental engineering in the area of municipal wastewater treatment, sewage treatment, and solid waste disposal, and to aid citizens in their decision making with regard to taxes, economics, voting, and so forth in relation to water and wastewater treatment and solid waste disposal.

These issues were selected because each was central to urban living, to the packing of millions into small sections of the land, and each is an area where the public education system has failed to teach the technologies of water, air, solid waste, sewage treatment cleanup, etc. This last radio series was sponsored under the Environmental Protection Agency's Division of Environmental Education and is coupled with still another concept.

This new course in water and wastewater treatment produced by the American University for the Environmental Protection Agency utilizes radio and television, and also focuses on public meetings at churches, fire departments or police halls, etc. Many public interest groups such as the League of Women Voters, the Boy Scouts of America, the Junior Chamber of Commerce, and Soroptimist Club will be participating in these community sessions. Many of the inner city churches, public school PTA's, Mothers Clubs and any group where citizens are actively interested in organizing for their own environmental protection will be contacted when this program is complete. The format will be as follows: the lectures will be given from the American University Radio studio; after every fifth lecture, spokesmen will meet with citizens' groups in assigned locations for rap sessions, discussions and cracker-barrel sessions on questions at issue, technologies learned, and experiences shared over the five lectures immediately preceding the meetings.

This kind of public participation in face-to-face contact plus radio listening should encourage citizens to make the proper decisions at the voting polls when issues come up in relation to these particular environmental areas of water, wastewater treatment, and sewage disposal.

The study guide for this new course is more extensive than the study guide for the Ecology and the Human Environment or than the teachers' guide for "Asphalt Ecology". This document will actually be a compilation of articles directed toward different academic levels of interest in each one of the 20 lectures. In some lectures there may be four or five articles and in others there may be only three. One set will be at an engineering level, the others will be for the average citizen or even for high school students or junior high school students. The program will be completed and developed and turned over to the Environmental Protection Agency in June 1975.

These experiences in environmental education through radio, gained from "Asphalt Ecology" and Ecology and the Human Environment, could open education to using radio successfully as a way to communicate a comprehensive environmental problem to the general public.

DISCUSSION

Question: I was wondering if you ever considered having a day during the week when the students could call in while you were actually there?

Sager: They can call me every day from 6 o'clock in the morning till 8, on one number. And then from 8 o'clock to 4 on another number, and then in the evening on another number. I'm glad you brought that up. So I have extensive student counseling, and question and answer by telephone.

And then the mail-in process, when I comment extensively on the portfolios--what we really would like would be to have them call in their questions and take 15 minutes after the show for that. But I threw that out for the same reason that long ago I refused to have students ask questions in the lecture, because it's bad pedagogy. If you ask me a question while I'm talking, you raise your own hand, everybody gets lost because they've been telescoping down on their own point of view, and it's very distracting. So I decided that radio was about the same way. We sent out questionnaires, and very few people said they tuned in to the question and answer thing, so they might just as well call me personally and ask me the question, and not take up air time for that. But I'm glad you asked me, because we do have that mechanism.

One of the things that we have done recently was to get rid of the exam. But we do meet on Saturday mornings, and anyone who wants to participate can come. Usually out of a couple of hundred people who are taking the course, about 30 come. We have a discussion group. A lot of people, especially the youngsters, say, "I want to know who's in the course with me, Dr. Sager." The little ones like to get together, and they like to show off for each other too. If they're doing real well, they'll come; and if they're not doing real well, you never see them. So we do meet twice. That's not mandatory.

Of course, you always have the people who say, "You know, I could learn this from reading a book", so then you say, "Okay, go ahead. Read the book. Be my guest."

Don Cook, of the Environmental Protection Agency's Office of Education and Manpower Planning, moderated Session 16.

Question: I admire your industry, but I wonder how you manage to feel comfortable in the areas you would touch on in your in-breadth handling of this particular field?

Sager: Well, don't forget I've been in this field a long time, I've been an ecologist for a long time. When I first went to American University I was the only member of the Biology Department, and I taught five courses for two years while we were looking around to get other people. And most of these environmental protection things do involve biology, ecology, human health, things like that. I've been very active with the Executive Housekeepers Association in the environmental aspects of hospital management. I've given seven courses there. I give courses every year for Giant Food on ecological and environmental management for food and beverage handlers in microbiology. I've taught every "ology"--microbiology, genetics, invertebrate zoology, comparative anatomy and so on. So--I don't mind making mistakes. But I'm not going to really make mistakes in substance because I'm not going to go that deep. The one that has given me trouble is this one, because I'm not an environmental engineer. The thing is, you've got to have excitement. You have to make your voice excited and happy. And you can't be reading. It's very tough. So, I'm just not afraid, that's all.

Question: How do you project your interests into the actual processes that are used for, say, waste treatment engineering?

Sager: You see, I'm fortunate that I came out of a computer, I think, and I became chairman of this Congressional committee which is called "Effluent Standards and Water Quality Information Advisory Committee" under Public Law 92-500, Section 515 of the act. I became chairman of this committee with eight outstanding international sanitary engineers. Our job is to evaluate all industrial point discharges under Public Law 92-500. We found 27 of them. Up to now that's iron, steel, fiberglass, textiles, leather, whatever it is, you name it. It was a total immersion shock for me to learn sanitary engineering, but now, after 18 months of doing it every day, I feel perfectly capable of giving lectures in that area. I wouldn't do what Wes Eckenfelder does, and go build waste treatment plants for the steel industry. But I surely know now how it operates, where the pitfalls are and everything. This committee has also taught me political action, because I have to work with the Congress. We're a Congressional committee that is supposed to give advice to Russell Train with regard to what the Environmental Protection Agency says to do. We're supposed to tell Russell Train if it's right or wrong. But the act doesn't say he's supposed to listen. I learned to speak, therefore; I learned all about how committees and subcommittees work. If it weren't for that experience, I wouldn't attempt the water and wastewater thing.

The biggest problem in the administration of any technical agency in the federal government is that the administrator is not a technician. The administrator is an economist, or a sociologist. He may be a smart guy, but he can't understand what the technicalities are in the agencies. This is true right across the board, although there are a few exceptions to it, but not very many.

What I've been doing for the whole month of October is spending time not with the politicians but with the presidents and vice-presidents of the pulp and paper industry, the organic chemicals industries, the leather industry, and the meatpacking and the fruit and vegetable industries, their executive associations. I go and lecture to them on Public Law 92-500, on the waste treatment processes available to their industries for best practicable treatment for 1977 and best available treatment for 1985 and--we are trying to do that kind of education.

Question: I'm too far from the door, maybe, to raise this question, but word gets around that EPA is made up almost entirely of lawyers, not ecologists.

Sager: Oh, I don't think that's a fair statement. I would say that EPA has some of the finest scientists in it. But I would say that they're not running the show right now. The way the act is written, everything goes back to the lawyer, and that's not the agency's fault, it's the Congress's. The Congress put a clause in Public Law 92-500 that says to the industries, "If you guys don't like this waste treatment number that we're giving you, let's set it all down in terms of pounds and BOD per ton of product produced, suspended solids, and so on." So if you don't like the number, within 90 days after that number is promulgated you must go to file suit against the agency, because if you don't file within 90 days and you come to find out in 20 years that it's not right, you'll have no recourse under the law. So of course, the things are published and everybody goes right to court. So it's too soon to say which ones are filed because they're pro forma and which are filed because they're "pro substance". It is true that it has been called the Lawyer's Welfare Act of 1972, and that's why. That's the reason.

Question: Do you address political questions at the local level too, in your courses? For example, suppose in a community they have a beautiful waste treatment plant, but they're not paying the treatment plant operators enough to draw them into the plant. How do you get people to consider that?

Sager: People are very selfish, and there are two things that they're interested in. First is their pocketbook, and the second is their health--or vice versa. And as soon as you can begin to show the health aspects of proper treatment or not proper treatment, they'll get interested. You can't get down into benefits to the aquatic organisms because people are not interested in that. But they're interested in their own benefits.

Question: Most of the money that's spent right now for municipal waste treatment is for protection of dissolved oxygen in the streams affecting fish, and not for human health.

Sager: I don't agree with you. Perhaps the money is being spent in that way and that's your interpretation, but the fact of the matter is that we don't even protect human health. We have drinking water standards, it's true, and nobody can build anything new in my area unless there's already a sewage permit on it. Of course, you remember about three years ago, the people in Montgomery County couldn't drink their own water from their own wells because it was coming up foam, full of detergents that had gone in from all of Montgomery County, it's nothing but septic tanks, or almost all.

Question: How many students do you have?

Sager: About 200 a semester. About 40 or 50 from the Washington area, but then we have a radius to Richmond, and Frederick, and Atlantic City. There's a college in Ocean Pines, and they use it all the time as a regular curriculum course. They have about 30 kids. So I have about 200 a semester. But only about 45 send me their portfolios. The other portfolios go to other people, or some don't take it for credit. And I don't know how many people listen to it. It's been a lot of fun. I've enjoyed it. It's exciting. I love to do something, you know, to try it and see if it will work. It's fun.

I think for a long time in the United States education has been too deadly and too stultified. I'm sure that we lose many of our children at junior high school. We do pretty well until we get to junior high school and then it's pretty boring for them. And I think it's because we don't teach them the things that they have to know. I'm all for teaching plumbing, and electricity, and everything else starting about the fourth grade. There isn't any reason they can't learn how to replace washers, and wire light bulbs and lamps. We now have driver education, but we still don't teach anything about the automobile. I think in a wheeled society we certainly ought to be doing that.

As educators we need to think of the things that our kids need to know and then teach it to them. Of course you'll have to do what I do, and that is, don't ask anybody; I do it first and then take the guff afterwards. I learned that when I was in elementary school and I had a supervisor who came in every six weeks and spent her day getting the blinds down, everything had to be in the right order. In the meantime I had a little science kit for the sixth grade. I had 74 kids in the sixth grade. We had so many we had to meet in the library. So I got together a whole bunch of wire, and cutoffs and transformers and old Christmas tree lights and telephone bells, and the kids worked for six weeks getting it all fixed, and then the circuit breaker was going to work and the first person who opened the door the bells would ring and the lights would flash. They were just waiting for this, and how did I know that the superintendent was going to be in the building? So the next day I got a lecture about what the science kit was and how it worked.

I had some boys in there that were six feet tall. The principal wanted me to bring them back from the cafeteria at 12:20 and have them sit there with their heads bowed on the desk until ten munutes to one, whereupon they could go to the bathroom and come back for the afternoon. Well, if you've ever had 75 writhing sixth graders you know that this is an impossibility. I was teaching dancing at the time to make some money on the side, so I brought my records in and we were having a wonderful time. We had a dance club. And we danced every day from 12:20....We had glass doors like libraries do, and had to put posters up so nobody could see in. But she found out about it and she called me in and said I was encouraging sexual activity. But you just have to be prepared for those setbacks.

INDUSTRIAL NEEDS FOR ENVIRONMENTAL TRAINING

D. E. Olesen

Industrial needs for education in environmental subjects are many and varied. In order to present these needs with some meaningful relevance, it seems necessary to initially discuss the actual activities in industry which create these needs. Broadly speaking, industrial activities having some relationship to environmental interests can be classed into four categories.

1. Operational
2. New Facilities
3. Developmental
4. Regulatory

Operational activities are those associated with existing facilities. These in the main are of a monitoring or measurements nature. Presumably the system, process or facility is licensed to operate and possesses the necessary permits from the appropriate regulatory agencies. However, operational permits from regulatory agencies typically concern themselves among other things with monitoring effluents or discharges to the environment to insure compliance. The required measurement or monitoring activities may involve discharges affecting any or all of the set of air, water, biological, or land resources. In all of these resource areas the measurement and analysis needs may be physical, chemical, or biological. Another aspect of operational environmental activities is the accident or emergency situation calling for a variety of actions including problem identification, implementation of contingency plans, cleanup, damage assessment measurement and monitoring for short and/or long-term effects, and interaction with regulatory agencies.

With only cursory consideration of the variety of industrial organizations which exist, the diverse environmental surroundings due to location, and the comprehensive nature of environmental-quality related legislation, one is led to the conclusion that many scientific and engineering disciplines are required by industry to meet its operational needs.

The new facilities category has several environmentally-related aspects, including system planning, site selection, construction effects, preoperational

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Sumner M. Morrison moderated Session 17.

evaluations, and regulatory interactions. As above, these activities can and do involve air, water, biological, and land resources, but also interfaces between technological developments and the environmental disciplines.

Regulatory activities are those associated with the many environmental interfaces between industrial organizations and various governmental entities. These interfaces do involve a multitude of environmental subjects just as each of the above categories does.

The key question here today is, "how does industry meet these needs for expertise in environmental subjects?" Obviously, the educational community has been, and will continue to be, the principal source.

In recent years concern over environmental quality has grown very rapidly as evidenced by a number of activities including new and more comprehensive legislation, larger expenditures to protect environmental quality, greatly increased pressures from environmental protection groups, and finally a greater awareness of environmental quality and the need to protect it by the general public.

Because of this expansion and interest in the environment, consideration of environmental problems by industry has, of necessity, become multifaceted. By this, I mean analysis and solution of environmental problems now require a substantially more comprehensive approach than in the recent past. Industrial organizations at one time were only required to concern themselves with some level of treatment of discharges aimed at preventing what might be termed immediate vicinity gross environmental damage. However, in the current and developing public arena, consideration of waste treatment is necessary but no longer sufficient. Such additional factors as resource recovery and recycle, long-term biological food chain effects, interactions with other discharges in the vicinity, transfer of contaminants from one medium to another (e.g., air to water), and cost/benefit analyses considering alternatives are often all part of managing industrial environmental activities.

All of this would suggest that industry needs for environmental education must have also changed. In past years, what were the primary needs of industry for environmental education? Although I am somewhat hesitant to answer this question, I will, with the understanding that everyone probably has personal opinions on this subject but hopefully a general consensus is possible. Specifically, the following environmental disciplines have had major historical significance:

--sanitary engineering
--biology
--chemistry
--hydraulics
--hydrology
--chemical engineering

Today's list of environmental disciplines is substantially greater than that just presented and includes, but is certainly not limited to:

--environmental engineering
  wastewater management
  water resources management
  solid waste management
  air resources management
  air pollution control
--aquatic ecology
  marine
  freshwater
--terrestrial ecology
  plant
  animal
--biology
--chemistry
--hydraulics
--hydrology
--chemical engineering
--mechanical engineering
--economics
--natural resources management
--soils
--geology

In reviewing this subject it does not appear that we actually have had much real expansion, but rather a high degree of specialization within the original basic disciplines framework. This has probably occurred for a number of reasons including the need for greater emphasis on particular problem aspects to achieve a full understanding and an increasing awareness of the complex relationships which exist in the real world environment.

Therefore as a minimum, industry has a continuing need for individuals in all of the above principal disciplines. It is difficult at best to suggest what the relative demands for each of the disciplines will be since the marketplace is a highly dynamic system. Within these disciplines there is a need for all degree levels (i.e., B.S., M.S., and Ph.D.). The range of complexity of problems facing industry supports this as a continuing demand. It would be nice to be able to put numbers on these demands, but I am simply not aware that the appropriate data is available in a comprehensive fashion.

In my own role as manager of an environmental research department, I review a rather continuous stream of employment applications from all over the country from individuals with environmental or related educations. It is apparent to me that changes in the educational backgrounds have and are occurring. This change appears to be in the direction of much greater emphasis on understanding the "big picture". By this, I mean education of individuals in such a way that they focus more of their attention on understanding that many factors are involved in environmental problems and that these factors are related in very complex ways. I suppose that this results in part, from a feeling of frustration that single-discipline training inadequately prepares one to deal with multidisciplinary complex problems of the environment today. At any rate we have certainly seen a substantial rise in the training of individuals through interdisciplinary programs. The question I raise is, "How effective is this approach to preparing individuals for environmental careers in industry?"

From my vantage point it does not always appear to be the most effective educational approach. The immediate response to this might be that individual-discipline trained people are unable to appreciate the significance of other disciplines and the many interactions such that they are not effective problem solvers in a multidisciplinary setting. However to really understand the reason for my opinion, it would probably be helpful to discuss briefly how multidisciplinary environmental studies are actually conducted in industry today.

First and most importantly, the concept of technical teams is well-established. For any given project a detailed work plan is evolved which almost always is composed of tasks which are discipline-oriented. Task and activity networks of some form are also developed which clearly show the interrelationships between tasks and particularly time sequencing of discipline work which must flow to other task areas in order for each task to be completed according to schedule. In each case where a task interaction or information cross flow requirement exists, the individual task managers negotiate a working relationship to insure a direct understanding of their respective needs and time constraints. Within each task a subteam of the proper disciplines is assembled. Thus, the project organization can be viewed as a grouping of specific discipline-oriented units which understand the key relationships which must exist. It is not, however, expected or necessary that each and every team member have a full appreciation of the effort to be undertaken by every other team member.

Heading up such an effort is a project manager responsible for the final product production. He is not necessarily required to have some expertise in all of the disciplines involved in the project. On the contrary, his role is technical administration which focuses on time, costs, customer interactions, and team communications. He is not expected to hold the primary responsibility for the technical quality of the contributions from each of the discipline-oriented tasks.

This responsibility must first rest with the task manager or organization discipline manager. The project manager must, of course, review all project work for overall quality and style. He certainly does comment technically to the extent of his ability. It should be stressed that managers of multidisciplinary projects are not typically selected because they can technically represent all of the disciplines involved, rather they are selected for their basic management skills.

This leads me to the conclusion that industry's basic and most important educational need is for individuals with extensive training emphasizing single disciplines. It is, of course, not reasonable to suggest total training in a single discipline. However, I do feel it does not serve industry's true needs to educate generalists. Industry is very comfortable creating its own generalists from on-the-job experience. It cannot easily do the reverse, that is make a specialist from a generalist.

I have personally interviewed numerous individuals and reviewed resumes from many others who have obtained what could be termed generalist environmental educations, many of these with advanced degrees. Although I cannot say what their original intentions were in selecting these educational directives, at the time of my contact they had serious desires to work in industry. In most cases they characterize themselves not as specialists in any particular area, but rather display interests in a broad range of subjects. They believe their major skill or value is related to this broad interest base and an understanding of how multidisciplinary subjects should be interfaced.

In effect the position which they desire is one typically filled by more senior members of an organization. They must in most cases enter the organization as an individual contributor rather than as project manager. However, to serve the role of individual contributor requires one to make major technical contributions in discipline areas; a work assignment which generalists are often ill prepared to undertake.

From personal observations I must conclude that some part of the justification for the educational programs which produce generalists is the belief one often sees to the effect that current environmental problems are so complex that only the ability to work across discipline lines can bring about the necessary solutions. I would certainly agree that some of the environmental problems we face are very complex, perhaps more so than we have ever faced in the past. My experience does not, however, indicate the generalist education programs can significantly contribute to the solutions. If, in fact, our current set of problems are more complex, this means to me that educational needs within the disciplines are greater than ever before. In fact, I often wonder if we have educated so many generalists in recent years who might have otherwise focused on particular disciplines that a shortage of strongly discipline-oriented individuals is now possible.

It appears at present that complex environmental problems can best be solved by greater discipline emphasis rather than less. With multidisciplinary project teams composed of discipline-oriented units, the entering professional must be able to serve in one of these units and hence the need for discipline educations.

Moving to another subject area, almost a universal deficiency which we see among technically educated people is poor to mediocre development of communication skills. Rather than emphasizing broader involvement in numerous technical areas, emphasis on communication skills may more effectively accomplish the discipline interactions which are today desirable. We continually see excellent technical work which appears to be only average when in reality the technical work is good but the communication skills of the individual are poor which, in turn, detracts from his technical accomplishments. Possibly the level of development of communication skills among technical people also contributes to the apparent need for generalists in order to solve environmental problems. It has been my experience that when technical people of one discipline do have good communication skills the interface with other disciplines presents no particular problems and the need for coordination between them is not apparent.

Another area which deserves some attention is the need or desirability of advanced degrees for industrial careers. There are certainly greater pressures today to get an advanced degree with the expectation that this will open many additional career opportunities. I would certainly agree that advanced degrees do open initial career opportunities which might not be otherwise available. However, I believe this is an area which requires careful consideration. At least to some extent the importance of the advanced degree is a status consideration as opposed to an indication of an ability to achieve technically.

For many people with whom I have had contact the obtaining of a Ph.D. has been a narrowing experience as opposed to broadening perspectives. The completion of research sufficient to satisfy the requirements for a dissertation normally occurs as the last phase in the educational experience and in the process focuses the entire attention and energies of the individual on a very special topic within his discipline for some extended period of time. This topic may or may not have any relevance to the individual's career. Thus moving from this type of effort to a potentially somewhat unrelated career path does require some substantial degree of realignment of the individual, a procedure which is not always straightforward. I believe the entire Ph.D. process requires close inspection with respect to how the mechanics relate to each individual moving into a career which, of course, is the ultimate objective, with the need to perform research to achieve some contribution only as interim phenomenon. I brought up the subject of the Ph.D. in part to make the point that it should be assessed in part from an industrial viewpoint. It has been my experience and, I think rather generally in industry, that a Ph.D.

does make a difference in the initial responsibilities one assumes in industry but then very often loses its significance as such; that is to say, within most industrial organizations real career growth is more a function of performance than education. Once inside a functioning organization, the really bright and capable individuals quickly become apparent. The old saying "that the cream always rises to the top," fits this situation perfectly. Thus, I would say that bright individuals can usually develop within industry almost without limit regardless of the educational degree which they possess. Of course given two equally bright individuals, the one with the highest educational degree level generally does have an advantage.

From this I would conclude that industry needs help from within the educational system in screening to focus on encouraging the really bright individuals to enter the advanced degree programs. This type of screening process is by no means simple since such mechanical measurements as grading systems certainly do not effectively select such bright people. As a matter of fact, industry attempts the same type of selection process in its recruiting practices. I might add that no one has come up with a foolproof methodology, at least one which has been made public.

What industry desires is that the really bright people have the opportunity to achieve an advanced education consistent with their career choices. In many cases, these bright individuals do not become apparent until they are in an industrial career position often with many responsibilities (job, family) and financial commitments. These factors can easily prevent such individuals from returning to school for any continuous period such as to fulfill residency or other particular requirements. For such individuals I believe we need more flexibility to tailor individual programs to permit them to achieve advanced degrees. It is really distressing to see those situations where the progress of an individual is hampered with respect to professional recognition not by his skills or level of contributions, but for lack of a degree. I have repeatedly seen cases of bright individuals conducting really outstanding original research in their work situation but this type of contribution does not apply with respect to the research required to satisfy degree requirements. Industry staff development programs as a whole could certainly benefit from some fresh approaches to this problem.

Some universities currently operate intern or exchange programs with industry in either or both undergraduate and graduate studies. Such programs permit students to work in industrial jobs during the course of their formal education. I believe industry as a whole would welcome substantial expansion of this type of activity. It has some obvious benefits for all concerned. The student, of course, generates an income to help offset some or all of his educational expenses, obtains on-the-job training which should help to focus his educational efforts and makes contacts which may be important to a later career. It offers the university an opportunity to work closely with a spectrum of industrial organizations which would hopefully be reflected in a more effective educational program closely tuned to the user community's needs. Industry gets the opportunity to screen many potential employees in an actual working situation and thereby should have less trouble in recruiting suitable new staff members. In addition, the working relationship with the academic community would hopefully increase the emphasis on continuing education. Such programs would have to be designed so as to not unduly lengthen the period of residency time required to obtain the degree involved.

The discussion of the use of intern or exchange programs brings me to a related topic on which I would like to make some observations. For any given discipline there is a considerable variation in the curriculum from university to university. I do not mean to imply that the subjects covered are different because I doubt that much variation exists in this regard, rather great differences exist within given subjects on how and what is presented. Obviously, some part of the difference is simply a function of the teaching skills of the professor and I will not attempt to suggest that any degree of uniformity can be reasonably achieved in this area. However, all professors or instructors utilize instructional resources which include textbooks, personally developed lecture notes, technical literature, and individual assigned study tasks, among others. The exact set of resources used is to a large degree determined by the individual professor. As an individual, his time resources are obviously limited with respect to continuing to optimize his educational package.

In addition, there are no mechanisms, to my knowledge, that provide for substantial interchange of educational packages between individuals at various universities. To a large measure individual professors must depend on the production of new textbooks and publications in the technical literature for new developments, neither of which are particularly efficient with respect to comprehensive coverage of new developments in timely fashion. I can visualize a cooperative program between universities under which qualified professionals are retained to develop annually critical reviews of all new and relevant developments within a discipline category which would then be distributed to all participating universities to use as they desired. The individual investments in such a program would be small but taken together would permit substantial work to be accomplished with respect to insuring each university had readily available the most current teaching resources. Industry would certainly benefit from the production of graduates from programs using this more current resource base.

A final point I would like to mention is related to the continuing education process. I believe substantial agreement exists throughout industry that continuing education is certainly required. Nearly every university operates some set of short courses, seminars, symposia, or other continuing educational vehicle. I would only say that industry encourages this activity and would readily welcome opportunities to participate even more than at present in the formulation and conduct of such activities. Also in the area of continuing education is the relationship of the university staff to the industrial staff. Certainly some interchange of staff takes place at many universities but probably not on the scale desirable. Just as industrial staff members require refresher-type experiences in the academic world, those in the academic world require direct exposure to the industrial world. I would suggest time periods not exceeding five years would be appropriate intervals for some sort of direct industrial and/or other non-academic work involvement. I do not believe that a consulting practice necessarily substitutes for this activity. It would seem that this type of exposure would benefit the educational process by way of helping to keep its focus very current.

To briefly summarize my remarks, I would like to emphasize a continuing need for individuals trained in the environmental disciplines. I believe you can pick anyone of the several disciplines which I discussed and would find ample industrial career opportunities for the bright, creative individual. We are certainly not saturated with such individuals in any discipline of which I am aware. In addition, needs exist within these disciplines at all degree levels but the degree level itself does not have to be career limiting within the industrial community.

One of the major points I have tried to make is that our needs for training are primarily discipline-oriented and not for general-type educations. Providing a generalist-type degree to an individual, will in most cases, in my opinion, slow that individual's career development as opposed to a more singular-discipline education. Multidisciplinary environmental projects are typically staffed with teams of discipline-oriented individuals.

Finally, I believe that a closer relationship between the academic community and industry could provide improvements in meeting industrial educational needs in the areas of curriculum, intern programs, faculty/staff interchanges, and continuing education.

ENVIRONMENTAL TRAINING FOR INDUSTRY

Matthew Gould

We regret that the tape recorder malfunctioned in Session 17, and it was not possible to obtain a manuscript of Mr. Gould's pap[illegible]

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ENVIRONMENTAL TRAINING FOR CITIZENS

- To Enable the Earth to Survive -

Donna Parsons

INTRODUCTION

First let me tell you a little about just what the Regional Studies Center is. It was started by the College of Idaho, which is a small, church-related liberal arts school, five years ago to find off-campus opportunities for college faculty and students and at the same time to serve as an information center, a clearinghouse, a point of contact for people of the Snake River Region--which includes most of Idaho as well as parts of Wyoming, Utah, Nevada, Oregon and Washington.

Among our activities have been interdisciplinary research, folklore conferences, environmental education workshops for teachers, summer programs for kids, lecture series on the quality of life for the public, and many other projects. We have from the beginning had a strong interest in helping the public learn about and plan for the world in which we live.

I want to talk today about

WHO?
WHY
WHAT? and
HOW?

WHO?

First, who are the citizens we're talking about? I want what I have to say to apply to all citizens--not just middle-class, middle-aged whites, or college graduates, or

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- --the employed but also the unemployed
- --the young as well as the old
- --women as well as men
- --members of all racial minorities

They are all citizens entitled to the kind of training that will help them succeed and survive in this world.

I realize that the poor and the sick may spend all their energy just trying to stay alive without worrying about what we commonly think of as "citizenship" and the environment.

But I believe such people have a greater stake--more to gain--than anyone else for they have less choice of where they live or what jobs they can take. So while much of what I advocate may seem to be possible only for those in "comfortable" circumstances, it is of importance and should be available to all.

WHY?

But why is it necessary to talk about environmental training for citizens?

Would a meeting like this one today have attracted an audience 30 years ago? 20 or 10 years ago? I doubt it.

How come this is the first Exposition with an environmental theme?

All I remember of the World's Fair at San Francisco in 1939 (as a mere child, of course) was the free balloons they gave away, the premature babies in incubators, and the huge ads for Sally Rand on the midway.

How come the change? We've always had pollution. Why didn't it do us in earlier? Why get excited now? Two reasons: You all know that only recently has modern science been powerful enough to have an enormous impact on the environment. We've had something else going for us and that is the lack of density of people. If one settler put waste into a stream every mile or so, dilution was truly the solution to pollution. But put 160,000 people--or even 10,000--in a few square miles, and obviously problems will result unless action is taken.

I could go on, but you can think of your own examples of how increased technological power and increased population have caused pressures and problems.

As Proust said, "There is nothing more terrifying than ignorance in action". There are few things more expensive to society at large than ignorance in environmental action. We must understand the consequences of our acts and figure out ways in which those which are adverse to the environment can be reduced or eliminated. Okay, so we must understand the environment. But hasn't past education been effective? Why bother talking about it?

We apparently have not been completely successful in education or otherwise why would we have allowed the use of detergents which kill fish and put foam on drinking water, or medications (Thalidomide) that cause birth defects?

Not all our failures or deficiencies in education have been tragic--some merely comic--as evidenced by responses I used to get from my students--who obviously had failed to learn. In earth science, latitude tells you where you are; longitude tells you how long you have to stay there. And overheard in physics lab while using a caliper: How many thousandths do you suppose there are in an inch? I don't know, but there must be a million of them!

And perhaps this comment of a British psychiatrist is just as true of the United States as the United Kingdom:

> A child born today in the United Kingdom stands a ten times greater chance of being admitted to a mental hospital than to a university....this can be taken as an indication that we are driving our children mad more efficiently than we are genuinely educating them.
>
> British psychiatrist R. D. Laing

Well, enough of the Why? Let's get to the What?

WHAT?

The formal education that everyone needs to survive and to enable the world to survive includes

1. knowledge
2. techniques and skills

Teaching is described in this rhyme:

The decent docent doesn't doze
But teaches standing on his toes
The student dasn't doze and does
And that's what teaching is and was.

Scientific principles are basic. But in addition to the ones we commonly think of such as:

All living things consume oxygen.
Matter has mass.

and those which explain electricity and magnetism, much more stress must be put on the Laws of Ecology--as expressed by Barry Commoner:

Barry Commoner's Laws of Ecology

1. Everything is connected to everything else.
2. Everything must go somewhere.
3. Nature knows best.
4. There is no such thing as a free lunch.

!

so we won't get ridiculous headlines like this:

PRESIDENT NIXON DECLARES WIN OVER ECOLOGY

or

ECOLOGY LOSES OUT AS AGENCIES BATTLE

We must understand--not only intellectually but in our whole being so we will behave as if we know it--such principles as the Second Law of Thermodynamics which means there is a limit to what we can do with energy and how much energy we can get out of anything--that energy is constantly being degraded into an "unusable" form. We must experience such learning. That's why internships and field experience are most important for college students and even for high school students.

For example, when students in the summer Youth Conservation Corps spend all day digging a hole for a sign, or building trail, they are extremely intolerant, to say the least, of anyone who might shoot at the sign or tear it down, or cycle riders who might tear up their trail--they've "experienced" something they'll never forget.

But while an understanding of science is important, that alone won't make us good citizens. You've heard statements like this: "A civilization that can put men on the moon can surely solve the problems of poverty, the city, mass transportation, and crime in the streets."

Wrong! It was single vision that put men on the moon (a technological problem with a technological answer). Only a civilization guided by Darwinian minds --minds that recognize that "we can never do merely one thing"--that recognize the interrelatedness of things, can solve the problem.

> In this technological age, ignorance of science can be dangerous. It is inexcusable in those who have talents of leadership. It is immoral when the ignorant elect to lead and when the informed let them.
>
> Milton Burton
> Emeritus Professor of Chemistry
> Radiation Laboratory
> University of Notre Dame

But as important as science is, it alone doesn't provide sufficient knowledge for an effective citizen. Economics is important so we can count the costs, external as well as internal, because the almighty dollar is still powerful; we must understand taxation since this influences land use, a most important factor in today's world.

And we must teach history--how does the saying go?

> Those who don't know history are doomed to repeat the mistakes of the past.

We must study philosophy and values, for neglect of these only results in poor philosophy and poor values. I make no apologies for this, for valueless education is no education at all as far as I'm concerned. As long as we are willing to give reasons for teaching particular values, and offer people the right to choose, we need offer no apologies. Even the charge of "elitism" doesn't bother me, for "elite" means "the very best" and that's exactly what I want for everyone.

And in order to be effective in action, we must learn all we can from the field of political science: How do laws become laws? How does government work?

So much for subject matter, this is really nothing new, but what kinds of skills are needed?

--the ability to see the interrelatedness of things

--the ability to analyze and look at consequences

So we will do tests on chemicals before we use them; innocent until proven guilty is okay for people, but should not be extended to things! The larger our population, the more conservative our attitude toward new things must become. Remember Agnes Allen's Law:

> It is always easier to get into things than out of them.

This applies to marriage and the back seat of autos as well as environmental matters. For example:

> Our government is seeking ways to disperse the force of hurricanes spawned in the Atlantic. But an important part of the East Coast's rainfall results from these violent storms, and without them Mexico's lush Yucatan peninsula might possibly become an arid waste. If the Sahara Desert were to turn into a verdant countryside overnight, meteorologists contend that it would be foolish to rejoice until the full impact on global weather conditions was ascertained.

We must learn to observe, analyze, see relationships, and think ahead.

So now we come to the final and important question of How?

HOW?

Dr. George Lowe, U.S. Office of Education HEW lists ten items that delineate the scope of an environmental education program:

1. E.E. is multidisciplinary.
2. E.E. is community-oriented.
3. E.E. is problem focused.
4. E.E. is teacher-student oriented.
5. E.E. is both formal and non-formal.

6. E.E. builds on the past good work.
7. E.E. includes all components of society.
8. E.E. is not conservation education
9. E.E. is not a subject--it is a process.
10. E.E. could be an education reform.

What he says applies to both the formal K-12 type program of the schools as well as to "continuing education" in the broadest sense, and we must have continuing education, for:

> Learning is like rowing upstream: not to advance is to drop back.
>
> Chinese Proverb, as quoted by H. H. Hart

So what do I propose that is different or specific for citizens' training?

In addition to traditional education methods, I would suggest that schools teach the future: that students be taught forecasting techniques, that they learn to analyze trends (and to reverse those trends if they are undesirable), that they learn to examine alternatives, that decision-making be analyzed and studied so that when they get into positions of responsibility--through vocation or avocation--they can be effective and so:

> Planning might become a positive force for desirable change rather than a reaction to uncontrolled growth.
>
> Warren D. Fairchild
> Director of Water Resources Council

Teaching the future is a risky business: "Banks are guaranteeing 7½ percent interest until 1977. Unfortunately, nobody's guaranteeing a 1977."

I was interested in hearing the comments of the two previous speakers who advocated specialized training in a single discipline as a requisite for jobs with their organizations. I'd like to tell you about a special program at the College of Idaho. Instead of starting an Environmental Sciences program, we have implemented the Human Ecology Dimension which allows students to take a traditional major--English, history, political science, chemistry or biology for example--and then take human ecology as a second major, the purpose of which is to explore man's place in the environment, through seminars, special readings, etc.

An important tool for teaching for kids and adults is Simulations. As an example, under a grant from the Idaho Association for the Humanities, Dr. Syd Duncombe, University of Idaho, has devised Idaho Tomorrow, a simulation game that has been used extensively with service clubs and other organizations throughout Idaho. Simulations have been effective in Forest Service workshops, and in land use planning seminars, and many other situations. Much more use should be made of this technique for increasing understanding. Generally, it results in immediate involvement and provides viewpoints that no amount of jawboning could ever do.

We hear a lot about scenario writing--envisioning a future world and then attempting to explain how the system got to this state--such as: How will local energy needs be met in 1990?

The Delphi technique of consensus could be used much more than it is presently for real learning and understanding.

Ralph Nader says there are only four or five full-time citizenship jobs in the country while there is room for hundreds of thousands of full-time citizens.

I guess what I'm trying to say is that we should train citizens for citizenship in the environmental area as much as for anything else.

First comes knowledge, then understanding, and wisdom.

Citizens must first know what should be done, and secondly how it can be done. Specifically:

1. How can we get better laws? Need to understand lawmaking. Not that laws are the complete solution, but at least with laws--antipollution laws, for example--all industries start even and the ones with a conscience aren't penalized.
2. Learn to be a watchdog. Citizens need to know how to monitor laws once they are in effect to be sure they are implemented, e.g. Environmental Education Act of 1970: Although it had overwhelming public support, lack of administration support kept it from having a director appointed; its headquarters were moved four or five times the first year; the national advisory board wasn't appointed until a year after the law was passed; on and on....We need to monitor water/air quality, and monitor the social environment in consumer affairs as well, to keep industry and business honest.
3. How to get into the decision-making process of government agencies.
4. How to be effective in dealing with local government
   county government
   state government
   national government.
5. How to use Congress and the General Accounting Office.
6. How to testify effectively at hearings.

I could go on and on--maybe that's what I was supposed to talk about in the first place--how citizens can learn to do these things.

But there are organizations and groups that have been effective in doing this. The League of Women Voters especially almost has this down to a science. Student public interest research groups of the Ralph Nader type have been most effective. Citizen groups such as Massachusetts Tomorrow and California

Tomorrow, the state governments of Hawaii, Iowa, and right here in Washington with the Alternatives program, have gotten citizens involved in looking at the future. Colleges and universities have gotten into the picture, first through the agricultural extension service in many states, but also through other programs of community service.

For example, at the College of Idaho, we have had Land Use Planning Workshops for citizens in connection with the League and with state agencies; and we are currently preparing workbooks and simulations on Land Use Planning for teachers and citizens under a grant from the Environmental Education Office which will be used in workshops next spring.

People need a place they can go to for information, and this is just another function the colleges can serve. Again, if you will excuse me for referring to our college, a couple of gals came to us for information on sanitary landfills and ended up writing a monthly column, The Recyclotron, for the local paper on everything from solid waste to the Bonneville Power Administration.

There are many efforts, but we need much more. We need to reach the ones I talked about at the beginning of my speech: the poor, the racial minorities, the handicapped, the old.

Whatever is done, I would hope that as we change the world, it will bear the mark of our intelligence, not our ignorance.

We must learn from the past as well as look toward the future. The philosopher Kierkegaard once wrote, "We live frontward, but we learn backward!"

As we enter Futures Week here at EXPO 74, I will close with a profound statement from another philosopher: "Prophecy is very difficult, especially when it deals with the future!"

But this is an exciting time to be alive; the Northwest is an exciting place in which to live; and if we look for opportunities in our problems, life can be beautiful.

ORGANIZATIONAL AND INSTITUTIONAL IMPEDIMENTS TO INTERDISCIPLINARY RESEARCH

Denis J. Prager

THE NEED FOR INTERDISCIPLINARY RESEARCH

Complex societal problems such as protection of environmental quality cannot be solved through the efforts of any single professional group or scientific discipline. Identification, definition, and implementation of effective and acceptable solutions to such problems require the coordinated efforts of administrators, policy-makers, program implementers, the commercial sector, and scientists of a variety of disciplines. The information and knowledge on which such solutions, actions, and policies are based result from fundamental and applied research defined, planned, performed, and disseminated by scientists from a broad array of disciplinary backgrounds.

IMPEDIMENTS TO INTERDISCIPLINARY RESEARCH

These sound like "Of course, what else?" statements; and indeed, there is considerable pragmatic experience to back them up. Yet in practice, interdisciplinary research is:

--rare;
--difficult to establish;
--difficult to perform; and
--difficult to administer.

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It soon becomes clear to one attempting to establish and administer interdisciplinary research that these difficulties, in large part, are the result of organizational impediments to the establishment and performance of true interdisciplinary research programs. However, these impediments are not inherent in the research organizations themselves but are the natural results of the educational and professional systems in which we are all born, raised, and nurtured. We can visualize some of the factors which underlie thsee organizational impediments by looking at some of the characteristics of the (1) educational system, (2) research community, (3) individual researcher, and (4) research organization:

The Educational System

1. Graduate scientific training is normally quite narrow in its disciplinary focus.
2. Dissertation research is usually within a single disciplinary department, under one professor.
3. Such training promotes a disciplinary focus and a tendency to narrow specialization.
4. There is little emphasis on the practical applications of such disciplinary training.
5. There is little if any attempt to help students establish linkages between theoretical research and its practical application.
6. Post-graduate training (such as post-doctoral fellowships) often leads to further specialization.
7. The "buddy system" of job placement perpetuates disciplinary bias and specialization.
8. There is no training in interdisciplinary communication. In fact, our disciplinary languages tend to preclude communication across disciplines.

The Research Community

1. Traditionally, professional societies are disciplinary; often there are sub-disciplinary sections for narrower specialties.
2. Professional journals are disciplinary; sub-disciplinary journals often provide publication outlets for narrower specialties.
3. Disciplinary professional societies and journals promote intra-disciplinary peer competition for visibility and recognition leading to an even narrower specialization, a reluctance to work interdisciplinarily, a tendency toward theoretical and methodological research without problem focus.

4. Publications in interdisciplinary, problem focused journals carry less prestige and earn fewer "points", further reinforcing disciplinary emphasis and avoidance of pragmatic research.

The Individual Scientist

1. Individual scientists come to the research profession with a narrow disciplinary training, an academic orientation, and little knowledge of research applications.
2. Such scientists are often interested in the performance of research, not the solution of problems.
3. Scientists seek professional security through presentations at professional meetings and through numbers of publications in disciplinary journals.
4. Scientists seek job security through professional security; however, their job security often depends on teaching and/or other non-research responsibilities.

The Research Organization

1. Most research organizations have disciplinary departmental structures.
2. Such organizations invariably have accounting systems which mitigate against interdisciplinary, inter-departmental research.
3. They have difficulty solving problems such as:
   --Who pays for project development?
   --Who gets credit for "sales"?
   --Who recovers indirect costs?
   --Who has overall scientific and financial responsibility?
4. Research organizations have yet to devise means for evaluating scientists' contributions to interdisciplinary efforts or for encouraging participation in such efforts through incentives and rewards.

As a result of these factors, scientists:
--are poorly prepared to undertake interdisciplinary research;
--operate within a professional community which encourages and rewards disciplinary specialization;
--work within organizations which actively impede interdisciplinary research.

Thus, those scientists who overcome these impediments and seek out and perform interdisciplinary research are normally unusual in their personality, self-confidence, communication skills, breadth, and devotion to problem solving. Successful leaders of interdisciplinary research are generally "charismatic", unselfish, devoted to problem solving, and able to motivate colleagues.

THEN WHAT DOES IT TAKE?

Under the circumstances described above, what we get at best is multi-disciplinary research characterized by:

--interaction at the beginning of the project;

--the performance of discrete chunks of the project by the appropriate disciplines;

--a "product" which has the disciplinary bias of the project leader and does not really reflect the integration of the disciplinary inputs.

Actually, multi-disciplinary research such as that just described may be the precursor of true interdisciplinary research. Interdisciplinary research, in order to be significant and rigorous, must incorporate the best possible disciplinary research methodologies appropriate for the particular research focus. Thus, the actual performance of the research project may indeed involve a number of separate, discrete, and parallel single-discipline efforts designed to understand and solve specific aspects of the research problem. The critical phases of the research as far as the significance and importance of interdisciplinary interaction would appear to be the beginning and the end; that is:

1. the precise definition of the problem to be studied;
2. the definition of the specific research approach to be taken;
3. the analysis and evaluation of the data collected;
4. the definition and presentation of conclusions; and
5. the dissemination of the research conclusions to those charged with implementation.

However, true interdisciplinary research cannot result from infrequent and sporadic contacts among scientists of a number of disciplines. Rather, the kind of interdisciplinary research which results in a research "product" which is much greater than the sum of the disciplinary contributions and is unique in concept, scope and approach can result only from extended, day-to-day interaction of such scientists. Clearly, such interaction cannot be forced. One can only provide a physical and intellectual environment conducive to such interaction and rewarding of the fruits of interdisciplinary efforts. Hopefully, the result will be a gradual and evolutionary communication among the collaborators resulting in better understanding of the various disciplinary perspectives, in unique, interdisciplinary research approaches to problem solving, and in the performance of research which is unique in its broad grasp of the many aspects of major societal problems.

The kind of long-term interaction which appears to lead eventually to interdisciplinary research is often the result of the focusing of attention of a number of scientists on the solution of a complex problem. When one becomes interested in applying his scientific expertise to the solution of a complex societal problem, for example, it quickly becomes clear that a large number of disciplines will be needed to contribute to the discovery of effective and acceptable solutions. Thus, often, the commonality which binds scientists in an interdisciplinary research effort is the problem which they are all devoted to solving.

THE NEED FOR ORGANIZATIONAL INNOVATION

If we are serious about fostering interdisciplinary research--and we must be if we are serious about contributing to the solution of major societal problems such as those related to environmental quality--we must take steps to introduce innovation into the research organizations in which we are involved. While maintaining rigorous standards for the disciplinary competences which we maintain, we must begin to explore ways of focusing these disciplinary competences on societal problems which require their collective contributions.

In addition, we must begin to understand the sometimes subtle but insidious impediments resulting from the kinds of accounting practices in place in major research organizations. Indeed, we must be as innovative about such mundane things as accounting as we are about the research we undertake. We must find ways of providing project development funds to scientists of different disciplines and different departments, of assuring that credit for "sales" is evenly distributed among the various contributors, of dividing up the indirect costs resulting from the project among the various departments represented, and of assuring that each department contributing to the project is satisfied with the scientific and financial management.

Perhaps more importantly, we must bring some innovation to the ways in which we reward scientists for their research efforts. If we continue to put emphasis only on publication and especially on publications in prestigious disciplinary journals, and if we continue to penalize those scientists who contribute to projects in other departments, then we cannot be serious about our devotion to interdisciplinary research.

SUCCESSES AND PITFALLS OF INTERDISCIPLINARY RESEARCH--INSTITUTIONAL ADMINISTRATOR'S VIEW

Frederick W. Crawford

I shall talk mainly from the point of view of someone in a private university. That raises a variety of problems which are not quite the same as those of big public institutions like the University of California. The financial outlook at the moment is very bleak for the private universities, and fund-raising of one sort or another beyond tuition is essential to their existence. We have two major functions, teaching and research, in contrast to the public universities where an element of public service is part of their charter and activity. In those two activities, research and teaching, we have to offer some particular excellence, or some special variety of experience to students; otherwise, they are not going to pay the much higher costs of attending a private university rather than a public one.

Since World War II one of the foundations on which we have built that excellence has been research, which has been largely funded by federal sources. Indeed, although much of our income is in tuition, and gifts from alumni, foundations, etc., more than a third of the Stanford consolidated budget comes from federal grants and contracts. It is important, then, that universities such as Stanford should be sensitive to the current mix of funding agencies in Washington. We need to match our faculty interests to agency interests in a way that is both fiscally and academically advantageous to us, but at the same time we should avoid being "captured" by them.

Over the years, we have reached a situation in which our faculty is mainly interested in basic research, i.e., the type of training that we give to graduate students is biased towards basic research; in principle, we supply them with tools that they can go out and use on more practical problems. In practice, however, a large proportion have gone into university teaching. That has changed markedly now that the expansion of the universities has halted. In the building up over the last ten or fifteen years, private universities such as Stanford have been able to move in the direction of pure research, rather than applied, because even those mission agencies such as the Department of Defense, whose missions were applied, supported a considerable amount of basic research. They were prepared to

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do so because they realized that the applied work that they wanted to do needed a bank of basic research results on which they could draw. In a sense, the basic research could be regarded as an investment for future applications.

In this climate, the recruiting of faculty, and the selection of graduate students, was predicated on the importance of basic research; somehow people capable of doing basic research were more rare, and better university material, than people who did applied research. Of course, it is not at all clear in what sense that philosophical belief is correct, or that people who can do abstruse basic research are more rare than those who can invest or develop solutions to highly practical problems. The debate might remain a philosophical one if it were not for the fact that the mix of mission agencies is changing: the NASA and the DOD are either steady or declining; the NSF is becoming more applied, with divisions such as Research Applications (RANN Program) receiving a large part of the total budget; a new agency, Energy Research and Development Administration, has been formed to coordinate energy activities; budgets for research of a highly applied nature are growing in agencies such as the Department of Transportation and the Office of Technology Assessment. The whole kaleidoscope of Washington funding has changed, and the new pattern has brought with it opportunites for a considerable volume of applied research to be funded. It is, however, of a much more immediate, crisis-type, societal nature than the sorts of problems that the present faculties of private universities such as Stanford have previously demonstrated a capacity for. Since there will not be a significant increase in faculty numbers, the question is, "How will the present faculty respond to the new opportunities and challenges?"

It is not at all easy to change from long-term basic research to applied research on short-term problems. The mode of operation is different: the essence of basic research is that you respond to the intrinsic pressures of the discipline, trying to find out what is wrong with its structure and consistency. You might want to seek for paradigmatic changes, or simply pursue "normal" science, to take the Kuhn description. In particular, the basic researcher tends to follow the sideshoots that are interesting, often in directions that were not anticipated at the time of writing a proposal for support.

Applied research, however, is rather different; there is the extrinsic pressure of solving the precise problem that was set. If it is a substantial interdisciplinary program, the researcher is locked into a team, and may find that organizations such as RANN insist on certain deadlines, milestones, and other short-term goals being at least specified in proposals (even if not subsequently met!). Such an approach is probably necessary for effective teamwork. If you are going to solve a problem with precisely set milestones, however, there is a basic incompatibility with the idea of research itself: milestones can best be met when working with extant knowledge, and if it is done by a group of people, projects can be carried out in parallel. Independent of whether you shatter any paradigms, research tends to proceed via steppingstones. You have to solve A before you go on to B, and so on, in series. The applied researcher may have to work with unfamiliar colleagues: it is not usual for basic researchers to deal with user groups. It may be that the solutions that the sponsoring agencies have chosen to explore have been chosen politically, rather than as the most appealing technological or scientific solution to a basic scientist.

When one tries to come to terms with applied research in the university, we rapidly realize that the university is essentially a vertically-structured organization, with teaching, research, and its reward system defined about separable domains of knowledge, and that this structure does not change quickly. To satisfy the requirements of interdisciplinary research on societal problems, you must overlay new "horizontal" organizational structures.

Putting together interdisciplinary horizontal structures could be viewed with detachment as a strengthening of the university fabric by putting a warp across the weft. Unfortunately, of course, it tends to be viewed more apprehensively by the entrenched vertical structure as a fraying of the strands! There are consequently a number of problems that arise which are purely political ones internal to the university. We could escape more readily if the university were still in an expansion phase. At Stanford, it was felt that for a situation such as we have now, where the creation of any new program reduces, or at least modifies, the effort available for other programs, we should try to crystallize out the set of relevant issues which have to be settled before creating any new organizations.

We chose to do it by creating a new organization, of course, the Center for Interdisciplinary Research. This consists of myself, and two other people who carry out various administrative activities, aided by an Advisory Committee consisting of the Associate Deans for Research (or equivalent) in each of Stanford's seven schools. When an interdisciplinary program with more than just one or two faculty members, and which is likely to impinge on more than one school, is proposed, we try to pose a variety of questions to its sponsors designed to determine, first, whether it is likely to be a viable organization, and second, whether it is going to be better than what it replaces or what Stanford must forego to produce the new entity. There are actually about 15 questions on such topics as junior and senior faculty commitment, and the views of the relevant departmental heads and deans on the effects of participation in the new program as far as tenure, promotion, and career development are concerned. Here, we try to head off programs for untenured faculty, so that they do not go blindly into new programs.

We are interested in what the student involvement will be in the program; what case can be made that graduate students and undergraduates will get more out of the new program than existing programs that the participating faculty have been interested in. What is the funding pattern likely to be? A problem with interdisciplinary research is that sponsors may want to make a massive attack for a period short on the time-scale of Ph.D. training: it is an embarrassment to be offered $1,000,000 for one year; $200,000 for five years is much to be preferred. (We are in the education business, not in the business of quick fixes for societal problems!) We are interested in knowing what duplication of resources is involved in setting up a new program. To what extent are the faculty retraining themselves for the enterprise? Movement towards the peripheries of their fields may be beneficial, but major leaps may be disastrous. Not only does it seriously disrupt their previous activities in research and teaching, but also it just is not clear that a very good accelerator physicist, say, is going to be a good ecological modeler.

To conclude, let me make one or two observations. First, I suspect that the most effective and viable interdisciplinary research in the university is that which preserves or erodes least the local departmental structure. By operating at the peripheries, it will effectively accelerate the evolution of departmental interests. Second, one should be suspicious about programs that involve significant retraining of the faculty, or duplication of effort in other parts of the university. Third, the evolution of programs should be responsive to student needs, and job opportunities. It may not be that by getting a very broad training in some interdisciplinary program they will be better off than if they had stayed in some specialized traditional department, perhaps as part of some multidisciplinary project. Fourth, an essential feature of any program should be a mechanism for evaluation and termination. In our own case, there is an evaluation after one year, and again after three or four years.

Over the next ten years, it seems to me that, with the pressure of societal problems and the crisis proportions that many of them have reached, the mission agencies to which the universities must turn for sponsorship will contain well-funded strongly interdisciplinary programs. It is essential for the universities to come to terms with this. We are going to find ourselves in some senses in competition with organizations like Battelle, Rand, SRI, etc. For example, they, and to some extent private industry, also have access to the funds that NSF has allocated to RANN. We would be wise to work out new collaborative activities for the university with such organizations and industry, recognizing those things which our faculty do best, i.e., basic research. There will always be some people in the best private universities who by predilection, and training, will be appropriate leaders in applied research. We should realize that the university in fostering the growth of this type of collaboration is defining a new role in itself. As we found out in the uneasy days of the late 'sixties, if there is one thing that universities do not know anything about, it is what their missions are! It is essential that the directions of the university should be much more clearly articulated. This can be done best by the faculty, and not by the administration. At Stanford, we are attempting to do so by posing at least the questions in one significant area through organization of the Center for Interdisciplinary Research.

VIEW FROM A PUBLIC UNIVERSITY

Donald E. Bevan

One of the hazards of coming last is to put together what remains that has not been covered by previous speakers. I haven't any spherical cows to take out of my notes, but there are some other things that have been covered which I will leave out. Keeping in mind that I'm to address my remarks as an administrator, I will. I do think it's important to point out that I am involved regularly in teaching. I am a researcher, both on team and on an individual project basis. It was interesting to hear from Russ Thompson this morning. I think I now understand why I have been successful in my contract research. Given that it's important to look to long term funding, I was reminded that I have a project as a one-year contract that is in its 26th year. It's trained a number of graduate students. I have a permanent full-time biologist associated with that project and maybe that's the reason for success. I've only had three of them over the 25 years. But they served for the continuity that lets graduate students come and go and allows me to wander from here to Batumi or Moscow or somewhere else and have firm control on the day-to-day management of that particular project.

Well, let me pull my administrative hat firmly down over my head and talk about pitfalls. I sometimes switch these hats around. I said something in a faculty meeting not long ago about my administrative hat. One of my colleagues said, "Oh yes, that's the one that comes down over your eyes and ears and leaves only your nose and mouth uncovered."

With that in mind, let me talk about some successes in research administration. One technique which I think is a success in our university is an administrative structure to handle difficult projects. By difficult I mean things like interdisciplinary research, classified research, academic computing and others. I think we've been somewhat successful, if not in managing those things, in administering them with the technique of gathering together a group of deans. We have established boards of deans and say collectively, "You are responsible for this project."

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Now, you can't run things with a committee, of course, so you either appoint, or the groups choose among themselves, an executive agent of the board to carry on the day-to-day activity.

Several things happen here I think. You have a person who has his own worries, you might say in his own discipline, but also his own tools for problem solving. He suddenly becomes the mentor of something that's been designated as having institutional support and a group of other deans to report to. Now I don't suggest that it's always as successful as the departmental structure. But compared to some of the other alternatives that we have, it has performed very successfully. We talk about the need for a matrix structure. You've mentioned that this is a vertical structure. Well, obviously, you rotate the matrix 90 degrees, set the university on its side and you solve the problem.

I'll leave the successes and talk about what I think are at least potential pitfalls because it's my view that it may be difficult to adopt successes from other places and put them to work in your own institution. But on the other hand, if you have some idea of the size and the dimension of the pitfalls, you can avoid them and success may come by itself. We can certainly design and fabricate our own pitfalls.

Now, when I first considered this discussion, I tried to approach it from the standpoint of whose ox is going to be gored: Is it the faculty member, is it the administrator, or is it the sponsor? I soon departed from any idea of trying to accomplish a division of the problems because if any one of these have any serious problems, the whole thing is going to come tumbling down. We're aware of the potential enemies and I suspect my first quotation is after Pogo. "We have met the enemy and they are us." We have some problems that we, I think, have to take care of ourselves.

The next quote I want to add to Pogo is from Orwell, if you remember in Animal Farm, "Four legs good, two legs bad". Well, we've heard quite a little bit about being locked into a discipline, the disadvantages that this has to bright, young people trying to start out in some other way; and I think we've got to be concerned about falling off the edge of the other side of the world, the world being flat in this case, where we're excusing poor disciplinary research because it is done in an interdisciplinary fashion. That, to me, is every bit as much of a danger. The disciplines have their place. I think perhaps Russ this morning talked a little bit about this and I don't think I need to follow it up too much. We can't afford to do second-rate economics or second-rate law or second-rate science of any kind in the interdisciplinary situation. Now, of course, there is the question of what is the definition of good and what is the definition of bad, and we heard a little bit about that this morning. I do want to point out that there is some advantage in the discipline being the guardian of the true faith in some respects, and that there is a need to make sure that we don't set up other enclaves that are different in quality.

Much of what I want to say from now on, you might think, relates to research in general. I plead guilty and say, "Yes, it does." But in my view, there's no apology to be made for a discussion about the pitfalls of research in the university environment. Pitfalls for research in general usually loom up very large and very important in the interdisciplinary scene because in most cases, interdisciplinary research is large. It involves a number of people. And where you have problems with research, you end up with problems in spades in large scale interdisciplinary research.

Now, some economic pitfalls. We had a few remarks about indirect costs along the line, and I heard the word "overhead". That's an area in which I think faculty need to have a better understanding. Administrators need to do a better job of providing information. And the sponsoring agencies have a responsibility to consider the costs of research, not just part of the costs. I think you mentioned we're going to have competition with not-for-profit and profit research institutions. In some respects, perhaps we should welcome that. We might use some of the techniques that those other kinds of institutions use. I fault a number of faculty for not understanding indirect costs. Now, certainly, in many institutions it is very difficult for the faculty to find enough information to reach an understanding. The fundamental misunderstanding in my view, is the word costs. Some people think that indirect costs are benefits, and that they can be passed around to something else. The normal scheme of things is that we identify costs and then attempt to recover these costs and, in most cases, do not do so completely.

Russ, in your paper this morning you had a statement that said, "An aggregate accounting is made each year to show how the university has used its overhead monies in general; however, no public accounting is made to show the overhead monies were specifically used to assist indirectly in the performance of each funded research project." Well, I'd like to give you the benefit of the doubt and come down hard on the word you used, "indirectly". I think if we were really able to do this, to show every investigator how he was benefiting from his particular collection of indirect costs, we wouldn't have any indirect costs. And the cost of doing that is the reason we have indirect cost. It's simply easier to put things into a bucket and average them out. That, of course, is our fundamental problem. Those of you with mathematical training will understand the problem of using an average. Hopefully, this is a distribution where no one satisfies the average, and half the people are paying too much and half are paying too little. So we usually satisfy no one. Averages can mean that very small numbers of people are handled adequately and most people are handled inadequately. In almost all institutions they're not completely collected. We need to look seriously at this problem and need to avoid a pitfall which I think will come up in trying to distinguish a difference in types of cost.

One other point that I think is important. Sometimes indirect costs are compared from institution to institution, and this in most cases is inappropriate. If 100 percent indirect cost rate is compared to 50 percent in another, it's quite possible that the institution with 100 percent indirect cost rate is much more efficient in carrying out its administrative and indirect cost operation than the one with the lower indirect cost rate. The institution with the lower rate may be spending too much money keeping track of the details.

Perhaps before now I should have defined a few terms so that you're absolutely aware of my biases on the subject. Let me just try a few.

Basic research: I define basic research as what I'm doing when I don't know what I'm doing, or research whose results only can be applied over a long period or over an unknown time scale.

Management of research: I would define this as the control of the research and decide that it's something that's not applied by the central administration of a university, or at least it shouldn't be.

Administration: I define this as the dispensing of services to those who control and conduct research.

And I hope I don't fuzz the issue now if I recognize that those administrative services may include the evaluation of the management that's going on and may include some, hopefully gentle, suggestions where management is being carried out in a less than satisfactory way.

Well, so far I've talked about intramural kinds of affairs and perhaps now is the time to consider some of the out-of-house effects. I'm reminded of a group of people we have to deal with, of whom one of my colleagues used to say, "God bless their mothers and their fathers too, if they can be identified." Well, I'm talking about federal bureaucrats. I don't feel quite that way about them, maybe it takes one to know one. I look upon a bureaucrat in any place as someone that is useful in our system of doing business. We may have more than we need at times, but we do need some of them.

In talking about the next problem I'd like to separate myself from my institution, if I haven't already in my remarks.

The Watergate atmosphere pervades the people that are looking at outside institutions. We've had crooks and cover-ups in high places in Washington, and because that's happened, we have all kinds of policemen looking for the same kinds of things somewhere else. I don't think it's any accident that at least the one set of General Accounting Office auditors that came to our institution came fresh from two years at Lockheed Aircraft Company and certainly brought with them the idea that what was going on at the University of Washington was some kind of government bail-out procedure which had to be looked at in exactly the same way that their experience had taught them in over two years at Lockheed. Perhaps they noted that we're the second largest government contractor in the Seattle area, and that what goes on across town is the way to do business where we are. Well, I wouldn't object to that so much if we could adopt a profit-making scheme, and perhaps we could pay for some of the real costs that arise from these government record-keeping activities. We're being asked to do things where the cost of doing the operation is far more than any possible estimate of a very bad condition. And I'm not suggesting that we have bad conditions. It's just that we're tying ourselves up in very costly schemes of looking at equipment inventories, of looking at indirect costs in a way to make sure that the government view always comes out,that we forget any averaging method. We're departing from that. And that's going to cost us and the government some money.

One of those areas, and I certainly hope that I'm not going to be misunderstood on this one, is affirmative action. Obviously we must do some things on affirmative action and have taken affirmative action. But we're getting wound up in the details about how we're to go about being affirmative by people who have themselves little knowledge of affirmative action. The laws don't apply to their agencies. Their record of affirmative action is not very good. Their understanding of universities is not very good and I would charge that if we spend a tenth of the money that we're spending on this gyration of how to do the job, on doing the job itself, we'd be much farther along the path of accomplishment. Our university president, at his inauguration speech not too many months ago, said that at least in the case of one federal agency looking at the university, it was a clear case of the pot calling the kettle white.

Somewhere along the line I've heard some rumbles about separation of teaching and research. I hope that, at least in the areas that I am acquainted with in interdisciplinary research, we recognize that it's a mistake to make hard separations. I'm perfectly satisfied that the best kind of teaching I do is when I'm involved in solving a research problem that is to be a topic for a graduate thesis. I'm sure, where graduate training is training students how to solve problems, and certainly much of our interdisciplinary and certainly environmental research is of that kind, we teach people how to do research by doing research and this is teaching. I believe research is training and teaching and the university is the place where it goes on. I don't care what kind of faculty activity analysis you have or what demands of government cost sharing must be satisfied, a set of categories that add up to 100 percent of somebody's time in the final analysis is nonsense. It may be necessary nonsense and we may need to provide systems to do this. I'm not saying that we can do business in the future without nonsense, but there are some real pitfalls here in the depth and the expense that we may have to go through in order to do this.

The same kind of thing happens in the legislative area, where legislators are prone to look at class contact hours as if they were some measure of efficiency of an organization. They look at community colleges, universities and four year colleges all in the same manner--as if you could measure the performance of a lawyer by counting the number of hours he spends in court. I suspect that one thing we need to do more of is to get into the legislative process so that these people understand us and we understand them. I noted in the newspaper here in Spokane just last night a meeting down the street which had a presentation by one of our state senators. Let me tell you what he said; I think he could say the same thing to us..

State Senator Sam Guess, Republican from Spokane, urged the group to take a greater role in politics, get to know your legislature. "I eat lunch many days by myself and I think this is wrong, when I could be discussing important things with the people who elected me."

When I go back home I intend to write a letter to Senator Guess with a standing invitation to have lunch with the faculty of the University of Washington. Some institutions have discussed limiting the amount of research. I describe that as thinking about the unthinkable, but we're starting to think about it and talk about it.

That mix of what is teaching and supportable by the state, what is research and supportable by the federal government, is--if we begin to draw firm lines--the greatest pitfall that's in front of us.

I might use a comment here that our faculty senate chairman made the other day at the beginning of his speech. I'll make it at the end. "If I failed to insult someone, why please excuse me."

INTERDISCIPLINARY RESEARCH:
THE OUTLOOK FOR THE NEXT DECADE

Robert C. Stephenson

The forecasting of the outlook for interdisciplinary research in the next decade is a task of elephantine proportions. There are so many problems needing interdisciplinary study and so many constraints that bear on our capabilities to perform interdisciplinary research that the task of forecasting is indeed of large proportions and, like the elephant, contains large expanses of gray areas. Because the problem is so large I propose to reduce it to somewhat more manageable proportions.

I propose to delimit my discussion of the outlook for interdisciplinary research in the next decades in two ways. First, I propose to confine my remarks primarily to interdisciplinary research in institutions of higher education. Second, and appropriate to the theme of this symposium, Learning for Survival, I propose to confine my discussion to interdisciplinary research on conservation.

My basic premise is that during the decade ahead we, as a nation, must develop a conservation ethic aimed at making intelligent use of our natural resources and preserving--hopefully improving--the quality of our life.

In treating the topic of interdisciplinary research in our universities as it relates to the development of a conservation ethic I propose to:

1. Outline some assumptions relative to natural resources and quality of life.
2. Discuss some dimensions of problems posed by these assumptions.
3. Outline some challenges to universities in organizing interdisciplinary research to attack these problems.

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ASSUMPTIONS

The assumptions that I outline are neither new nor profound. Societal problems relating to natural resources and quality of life have been with us for some time--indeed we are sick of hearing of them--but these problems are chronic. They are with us today--they will be tomorrow.

NATURAL RESOURCE ASSUMPTIONS

--Many areas of the country will be faced with critical water shortages for domestic, agricultural and industrial uses.

--Demands for energy will exceed supplies and force conservation measures.

--Mineral shortages will become increasingly critical and will force conservation and the utilization of alternative materials.

--Development and exploitation of marine resources will be accelerated.

--World food demands will exceed supplies and will force improved management of agricultural production and distribution.

--Federal legislation will force improved management of land and coastal areas by state and local governments.

QUALITY OF LIFE ASSUMPTIONS

--The delivery of health care will be an issue of major concern.

--The welfare of children and the elderly will require greater attention.

--Crime and delinquency will continue to be a societal problem of major concern.

--Pollution and waste management will continue to be primary issues.

--There will be growing pressures for the development of a new generation of mass transportation systems.

--Future economic development will be subject to a growing number of constraints.

--New legislation and modified political institutions will be required to protect resources and the quality of life.

--Basic changes will occur in our aesthetic, social and economic values.

--Societal pressures will force continuing change in the concepts and processes of education.

--Human stress will be recognized as a problem of growing proportions.

These assumptions are in reality a "laundry list" of some of the more obvious, perplexing and pervasive problems facing society today. These problems are likely to become more critical in the decade ahead. As we attack these problems through research and the application of technology, we must expand our considerations to extend into the full range of social, economic, political, legal, global relations and other societal impacts. Assessment of the various alternatives and the range of consequences of these alternatives will demand new levels of intellectual skills and analytical sophistication.

In working to establish the conservation ethic, our efforts to conserve natural resources and maintain the quality of life will depend upon our ability to communicate and understand the problems and issues. Our decision-makers and the various interested publics must have reliable information concerning alternatives and consequences. Furthermore, they must be educated to a level of understanding that will permit the use of this information to make reasonable and rational decisions. Continuous interaction between and among the decision-makers, the researchers and the interested publics will be essential to the successful attack on these problems. Those who are investigating alternatives for action and the consequences of those alternatives must seek inputs from the sectors of society that are likely to be affected. The investigators also have an obligation to communicate and interpret their findings to the decision-makers and the various interested publics.

DIMENSIONS OF PROBLEMS

The dimensions of problems pertinent to the development of a conservation ethic are many and complex. If we are to intelligently use the remaining natural resources of Planet Earth and maintain an acceptable quality of life we must organize our best brains from many disciplines into interdisciplinary teams that will scope the many facets of these problems and develop viable alternatives that will shape decisions for the emergence of the conservation ethic. If we are to pursue this course, the way will be difficult, many long-cherished amenities of the good life may be challenged, and the recommendations growing out of these problem-oriented studies may well be unpopular with many.

Let us look at some of the problems that must be addressed in the conservation of natural resources:

Commodity vs. Resource?

Land, minerals and water have traditionally been viewed as commodities which are traded in the market place.

Mineral and water shortages raise the question as to whether we should continue to let the market place govern the exploitation of these or whether they should be recognized as resources to be conserved for the public good. The Coastal Zone Management Act of 1972 and the impending Land Management legislation imply that our land is a resource to be protected in the future through public management.

There are those who advocate the public management of our natural resources for the common good of the public. There are others who feel that this violates the intent of the Fifth Amendment.

Indirect Costs-Externalities

When natural resources are exploited as commodities, the producers or users of the resources often ignore certain indirect costs--or externalities--which accrue as negative benefits to society. Strip mining without reclamation is a classic example. Another example is the Houston-Clear Lake-Baytown area adjacent to Galveston Bay. Heavy industrial use of ground water from an aquifer in unconsolidated rock has resulted in substantial subsidence with resulting encroachment of marine waters and severe damage resulting from storm surges. Industries are reluctant to opt for more costly surface water to arrest subsidence for their own obvious economic reasons, yet a recent study has shown that the direct costs of ground water plus the indirect costs of property damage, flood prevention and decreased tax revenues actually exceed the alternative direct costs of surface water purchase.

Balance of Payments

Mineral resources are a primary source of new wealth and are the life blood of an industrialized nation. In 1973 imports of mineral raw materials accounted for a U.S. trade deficit of $8 billion. In that year we were dependent totally on foreign sources for 8 mineral commodities and we imported at least 50 percent of more than half of the minerals used by American industry. Our seemingly insatiable demands for natural resources will continue to have a negative effect on our balance of trade.

Global Politics

Our dependence upon foreign sources for raw materials to feed our industrial machine increases our vulnerability to the pressures of the market place and those of global politics. The recent energy crisis has demonstrated the degree to which the pressures that the "have nations" can impact on the well-being of the "have nots." Many of the world's sources of metallic and non-metallic minerals lie in the so-called developing nations. We can expect these developing nations to organize into cartels that will wield increasing economic and political clout in the decade ahead.

These issues of commodities vs. resources, indirect costs, balance of payment and global politics are cited as indicators of the complex nature of natural resource problems that will require interdisciplinary efforts to seek viable solutions. It is easy to recognize that scientists, engineers, social scientists, lawyers and humanists must contribute the best of what they have to offer through carefully planned and fully integrated efforts, if we are to make substantial gains toward the solution of these problems.

To maintain the quality of our good life in the decade ahead--as we cherish it today--will also require that we vigorously address the more urgent problems through interdisciplinary efforts. Let us examine a few of the problems relating to the quality of life.

In the area of waste management we must look at the direct and indirect costs of disposing wastes and work toward a more equitable accounting and assessment of costs of waste disposal. There must be a serious effort to establish sound management practices in dealing with waste disposal problems.

Social and health related problems will also require the introduction of sophisticated systems management concepts, with interdisciplinary inputs to assure adequate identification of alternative courses of action and the resulting range of associated consequences.

Productivity-Technology

We have considered the broad implications of our declining raw material position. Another problem we face today is that there are segments of American industry which have lost their competitive edge in productivity to various foreign producers. This is due in part to lagging technology and in part to changing attitudes of workers. The establishment of the conservation ethic might embrace the rebirth of the "work ethic" which many feel that our nation has lost.

Packaging and Delivery

One of the vexing areas of inflation continues to be the seemingly uncontrolled escalation of costs in the processing, packaging and delivery of consumer goods from the producer to the consumer. This might be called by some "the middle-man rip-off." If we are to take hold of our destiny and establish our conservation ethic, we must bring this aspect of our American economy under critical scrutiny and seek alternatives for greater cost effectiveness.

Economic and Social Change

In many instances the science and technology necessary to solve problems of maintaining and improving the quality of life is available, but entrenched economic and social constraints continue to checkmate action. The mass transportation problem is one where social apathy is probably the most significant deterrent to action. The social scientists and humanists are challenged to take a lead role in the development of the conservation ethic through their efforts to change social and human values essential to the solution of societal problems.

Political Institutions and Mechanisms

Within the past few years we have seen a remarkable shift in responsibility for a wide range of societal problems from the federal government to state and local governments. This has come about as a result of the New Federalism movement, the initiation of revenue sharing, federal legislation placing responsibilities at the state level--for example, the Coastal Zone Management Act of 1972. Perhaps most important of all has been the realization that many problems can be solved only at local and regional levels.

These increased responsibilities are diverse and complex. Many of the problems are heavy in scientific and technological content. Many pose sticky economic, social and political considerations. There is reason for serious concern as to whether the state and local governments have the technical background to deal with these problems. State and local governments are likely to need an increasing amount of assistance in assessing and developing alternative approaches to these societal problems. More often than not these problems will have interdisciplinary implications.

Just as with the efforts to conserve our natural resources, the problems of maintaining the quality of life are complex and multidimensional. Interdisciplinary efforts will be essential in addressing these problems and the input of economics and social scientists will be critical to the development of understandings and alternative solutions.

UNIVERSITIES AND INTERDISCIPLINARY RESEARCH

The basic premise that we develop a conservation ethic to insure intelligent use of our natural resources and the preservation of quality of life in the decade ahead suggests that we will commit our best intellectual resources to attack the complex societal problems related thereto. A cursory analysis of this array of problems suggests that most are interdisciplinary in scope. Therefore, if we make a commitment to these problems of conservation we make a commitment to interdisciplinary research.

Our major research universities will normally have the array of talents in the sciences, engineering, social sciences and the humanities needed to field interdisciplinary teams to tackle complex societal problems. So universities should be big performers of interdisciplinary research. Are they? With few exceptions they are not. Universities have talked a great deal about interdisciplinary programs but have accomplished very little toward building truly interdisciplinary efforts.

The traditional concepts for organization and management of universities defeat their efforts to establish interdisciplinary activities. The faculty is organized into tidy disciplinary boxes--called departments. These boxes are stackable by deans into colleges. The departmental boxes are expertly reinforced against outside forces by the departmental budget. These reinforced boxes and stacks of boxes provide a simple way for university administrators to budget and manage faculty efforts. The faculty incentives and reward system is traditionally accomplished within the boxes and stacks of boxes.

Many universities give lip service to the concepts of interdisciplinary research but few make a commitment to it. The faculty who seek to engage in interdisciplinary research are often branded as mavericks or entrepreneurs. Frequently they find themselves outside the reward structure--outside of a box--and in an institutional budgetary vacuum. Many institutions through their own administrative inflexibility will carve an interdisciplinary program into multidisciplinary components. Often it is easier to acquire the part-time services of a researcher in a complementary field by hiring a consultant from another institution than it is to fight the rigid and bureaucratic appointment procedures for interdepartmental and intercollege transfers. The enthusiasm of faculty members from various disciplines to work together often flames out and dies when they encounter the problems of the boxes and budgets.

With this dismal commentary on the interdisciplinary research performance record by universities, what is the hope for the next decade?

Universities can organize to conduct interdisciplinary research but they will be successful only if they make both an academic and administrative commitment to interdisciplinary programs. Following are some elements that will contribute to such success:

- --Institutional assessment of most promising areas for interdisciplinary involvement.
- --Integration of interdisciplinary program planning into academic planning.

- --The development of administrative provisions for peaceful coexistence of departments and interdisciplinary units.
- --Institutional budgetary support for the development and basic core staff subsistence of interdisciplinary units.
- --Building of interrelated academic and research functions of interdisciplinary programs to insure participation of students (without penalties to students).
- --Development of administrative procedures for the widest possible cross-department and cross-college participation in both academic and research activities with the minimum of appointment and accounting red tape.
- --Provide regular academic appointments and privileges for key staff of interdisciplinary programs.
- --Develop adequate incentives and rewards system for participants in interdisciplinary programs.
- --Provide for periodic review of the scope, purpose and performance of interdisciplinary units and for the dissolution of units that have outlined their intended purpose.

Interdisciplinary programs focusing on conservation can contribute to the three missions of our universities--teaching, research and public service.

- --Interdisciplinary educational programs can contribute to the training of professionals in relevant disciplines, to the general education of college graduates and to the continuing education of decision-makers and the general public.
- --Interdisciplinary research, technology transfer and assessment can make contributions to the solutions of the complex societal problems relating to the conservation ethic.
- --Public service and advisory programs can carry the resources and knowledge of the universities to the people in the tradition and style of the land-grant institutions.

CONCLUSION

I have made a case for universities to take the leadership in developing a conservation ethic to focus on the intelligent use of our natural resources and the preservation of the quality of our life. This will require the application of research and technology that is truly interdisciplinary.

Universities have and can develop the intellectual resources for performing these services for society. However, their track record in interdisciplinary teaching and research is bad. Universities must make serious academic and administrative commitments to interdisciplinary research if they are to be leaders in the development of the conservation ethic as a part of our Learning for Survival.

DISCUSSION

Comment: One thing you said, Dr. Bevan, that's extremely important is that very often pretty bad disciplinary research is excused under the guise of interdisciplinary research. In fact, some of the people who drift into interdisciplinary research do so because they're not doing so well in their discipline, they're not competing well within their discipline. We need to continue to develop people who are extremely strong disciplinarians, but who know how to communicate with people from other disciplines; so that we should not diminish their disciplinary competence, but somehow we should prepare them better for interacting with others.

Answer: Let me go back to the other point of view, which I hope you don't want to lose. Sometimes very good research is being done that appears bad to the discipline because it isn't under their control. We have a mechanism in the disciplinary trade, so to speak, to look at that. You have a review and you have the promotion schedule. That, in most cases, doesn't exist in the institutes where most of this is going on. It's beginning to happen now. We're now getting institutes, one for environmental studies, one for marine studies, which have their own faculty. Now, not very many faculty are totally in these institutes. There are some. So there's more than one possibility for evaluating performance. It gets evaluated in the institute and also back in his, I was going to say, home base but it isn't always a home base; sometimes the home base is the institute. That provides us with a whole set of new problems which we've got to recognize. In some cases there's an initial evaluation of the institute faculty.

There are all kinds of possibilities here. I think experience over time perhaps is going to push us one way or the other.

Comment: It seems to me that the key to all professional research is identifying the question or problem, and then how do you marshal resources to solve the problem? Now, with regard to review, we found that it worked out very well to go outside the university. In fact, before any technical report is submitted

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Jack Fuller of the University of Washington was the moderator for Session 18.

to the National Science Foundation or included in publications, we go outside for technical review. Generally it has been very hard hitting from both an economic and an engineering point of view. We've had a number of reports fall through the slats. They have not made it.

Question: But where you go to get your review it's not interdisciplinary. When we are a little bit contrary to the classical paradigms of economics, who do you find to review the report?

Answer: Well, you go outside, to industry, government...

Question: But you don't find too much of that in industry, for example, a different approach to economics. They may be more conservative in terms of commitment to the established paradigms than your team is. So we still have the problem.

Answer: I don't think so. We've had very good success. Once in awhile we get a bad review. I mean, it seemed like the guy never really understood what we were talking about, but most reviews have been very hard hitting and constructive, and they come right to grips with the problem as initially stated, how to marshal resources to solve the problem and what are the results. And when you get a number of reviews you'll find common threads of important criticism, if there are weaknesses. We have found them to be very helpful.

Comment: If you are really doing creative, interdisciplinary research you want it to be good, rigorous. But the very nature of it is contrary to the traditional disciplinary paradigms. I could see that going outside for review might be one way, but there are some real shortcomings in that too.

Comment: The team plays an important role. You have a team with a number of good scientific people. If a member of that team is doing poor work, quite often they'll get on him. Then you get the problem of trying to get rid of somebody.

Comment: Also, teams get to be incestuous. They talk to each other so much that they begin to believe everything. It really is good to have somebody from the outside. We do the same thing.

Comment: I would like to respond to the question of how you bring people together and make things work. I think experience shows that you don't try, that you use your resources and your energy to promote the ones that are coming together by themselves or making some initial steps. A major university doesn't have to be engaged in everything. You mentioned that it's quite important to have good people. Even beyond good professors, I think you have to have good students.

Question: If you have someone who's the administrator and is also responsible for a scientific section of the research, what advantages and disadvantages can occur?

Answer: My guess is that in the case of a principal investigator of a large-scale project where the thing suddenly falls apart, it becomes pretty obvious what the problem is. It's not the team, it's the leader. Particularly in a university atmosphere, this isn't a boss and servant kind of relationship. After all, you've got colleagues working together and you've got to give and take here. You do have to identify someone who must take the responsibility to move the team. You have to have some leadership.

Comment: The point I'm making is that we are talking about review, we are not talking about checks and balances to get good work. If we're really going to talk about these systems we have to make the assumption that if there is bad work, there's a method of getting rid of that part of it. A lot of teams that I've talked to have indicated quite often that it gets very difficult to cut off a portion. If there are going to be those internal checks and balances that's one of the things that has to be there.

Answer: The way a program gets its start is you make up some sort of firm proposal which is very critically reviewed by the advisory group according to a list of issues and questions that we've crystallized out of previous successes and failures around the country as well as at Stanford. Then after it's been accepted for one initial year, one interim year, it must show at the end of that year that there's a good likelihood of funding, or that it's already got a lot of funding. Otherwise we would cut off any seed money or support that we were giving it through the university. That hasn't been the case with any of the programs that have come through. They've all done well in the first year or two, particularly the Institute for Energy Studies whose foundation came just about at the time that the energy crisis came upon us.

After three or four more years, after this interim period has gone by, we would get outside reviews from organizations which were similar in type. We would get internal reviews from people as near as possible to those domains. And written into the charter of our organization we would do two things at that stage: one would be to invite anyone else in the university who feels that they've got anything to say in that particular area or who might want to found a program of their own to meet with the leader of it to propose and comment on the program that already exists, and then we would deliberate and recommend whether those things should be cut off or not. I think you have to be very clear about scale in these things.

I don't know how many of you have read the book Beyond University Departments in which they classify a lot of these interdisciplinary efforts. They've a sort of taxonomy which is borrowed or developed from some previous work in which they look at interdisciplinary efforts in institutes, centers, programs, and so on according to the amount of resources that the parent institution has invested in them. They identified first of all what they call a standard institute, which is something that might have buildings of its own, a permanent administrative staff, maybe permanent faculty, and is a fairly difficult thing to get rid of because you have a large allocation of resources in it. The review for such an institute would be a deep and traumatic one, particularly if you wanted to cut them off.

The second level is the adoptive type of institute, the computer center which is something which stands out of an institute or a center for interdisciplinary activity, but through which people pass with the faculty trained from year to year. The people pass through, but the institute goes on. If after a time there's a big falling off, you might decide whether to cut that one off, but it's not quite so difficult because there's no permanent faculty associated with it, and its staff could probably be dispersed relatively easily.

And the third group is the one in which I find nearly all the interdisciplinary activity around the university falls and that is the so-called shadow institute which is very little more than a brochure, a set of people who meet for seminars, who maybe put a couple of courses under the blanket title of some program whose main purpose in having an institute at all is simply to increase their visibility to the outside funding agencies, and credibility perhaps. And their visibility to students and faculty members within the university. And those, since they're not very costly, you don't have to worry very much about how you get rid of them or what you should do with them. They can hang on for a long time without costing you too much. Certainly it works out with many institutes that you don't save much in the way of money if you do cut them off. You should always bear that in mind. And the human cost of cutting something off in some circumstances may well outweigh the balance that you'd save.

Comment: Let's say somebody wanted to start a program in technology assessment or something like that. First of all, we would probably offer them some seed money to do a little research, buy a little faculty released time. The sponsored projects office at Stanford keeps faculty research interests, potential interests, on a computer file, so we would try to match up and identify other faculty that they didn't know about. We would help them to bring the group together.

We also keep a very close eye on what's happening in Washington. And we will try to put them in touch with possible funding sources, agencies that might be interested in their activities. If it looked as though after a few months of discussion there was the opportunity for a viable program, and they could give pretty good answers to the questions that I mentioned earlier as to what their program would contribute, then we might charter them for a year or so to see if they could get going.

It's always though, I think, dominated by one entrepreneur. One, or at most two. The history of these university projects rarely seems to be a group of equals coming together. Someone is the prime mover. And one of the questions to which we attach a lot of importance in the review is, "How is that leader going to be replaced? What is the replacement? Is this a one-person show? What's going to happen if his interests change?"

Very often the sort of person who will float a venture like that is the sort of person who will hop out of it in a year or two, and then your question is, what are you going to be left with? Who is the next, not necessarily charismatic, we've already downplayed that word this morning, but who is going to be the really dynamic leader? Who's going to take this thing over and make it go?

Question: I would like to ask Dr. Bevan a question about indirect costs. On those large projects, quite a sizeable amount of money is involved in indirect costs. It seems to me that, within the university, both faculty and administrators should know how these monies are being used in a fair accounting for both parties.

Answer: I agree. In fact, you've got to go into such detail with the federal government that those documents are there. But I think many administrations make a mistake in making those available to interested individual investigators. The problem is, of course, that individual investigators want to see where those dollars are to make some sort of argument. Well, the investigators are being treated unfairly. Almost everyone in the institution is being treated unfairly. All we have is a big box of cost we've added up which we've now documented with the government and the government has said, "Yes. You can recover X millions of dollars." How do we recover it? Well, we've decided that in most institutions the number of people is perhaps a fairer way than the total dollars going through the project. So we say, "All right. We've got X millions of dollars to recover. We've got X millions of dollars of federal salaries. We'll make a simple ratio and for every dollar that we receive in a direct way, we'll spend 47 cents into this pool of costs that needs to be recovered."

Question: But the time spent writing the proposal is not recovered?

Answer: No, but the important thing is not so much getting more money, but having some sort of stabilizing mechanism so that if all of a sudden the grant gets cut off, the guy isn't either without a job or teaching freshman orientation.

Comment: I'd like to add a few points to this, because it's really an argument that has some very significant implications. If we identify and recover all indirect costs for proposal preparation, our indirect cost rates will look more like Battelle's indirect cost rates. Who will scream? The faculty will scream their heads off that the administration is trying to do them in, that they're using all their project funds for indirect costs. And most project directors in an agency like the National Science Foundation have come out of the academic environment and they may not have had any contact whatsoever with the administrative side of programs in the university. But when they get to Washington they're instant experts on indirect costs, and they're going to try to brainwash the principal investigator, and they'll try to beat the institution down. So it really is not a simple situation.

Comment: The instability of funds, particularly in the last few years, is not good. You can't get a three-year grant any more. You get something like a 12 months grant or something, so what a principal investigator who's living on his own grants has to do is diversify. So you end up being a hustler. He's writing these proposals and sending them out, and he almost has to be overcommitted in order to survive. There's a wastage there, a tremendous wastage. The people who get hurt are the people who don't want to build empires. The guy who really wants to do research almost has no choice. He has to devote a lot of his time to hustling first.

ENVIRONMENTAL ISSUES AND LAND USE PLANNING

James R. Pease

In many respects land use has been an economic or social issue, rather than an environmental one. Planning has served the needs of commercial and industrial entrepreneurs and supplied the services to accommodate growth and development. Its chief implementing tool, zoning, has been used to establish a set of rules under which property value is protected and the developer will have some idea of future speculative values.

Since Earth Day of 1970, things have changed. A deeply felt concern over the natural environment which provides the setting for our social and economic activities has manifested itself in diverse and important ways. Environmental concern is not a flash-in-the-pan, an eccentricity of a few birdy persons, or a luxury for an indulgent society. It's here to stay, which surprises and delights me, and we need to figure out how to incorporate the concepts and techniques of the resource specialist and ecologist into our planning.

Zoning, and other police power techniques, are now being used to protect from development as well as to protect for development. This is quite a different twist on the traditional application of zoning and is a reason we are uncovering new conflicts in our planning. Implementing plans now means restriction, and restriction implies economic loss, and economic loss places planning in an adversary role with respect to market economic forces. That is a serious problem and one which is currently receiving much attention throughout the nation. Ideas and techniques are desperately needed to harness planning objectives with economic incentives.

Environmental planning needs, of course, to be integrated with economic and social planning. Before the integration can be accomplished, a systematic method of dealing with the various environmental concerns needs to be devised and minimum base level standards established.

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Just what are the environmental concerns which are important to land use planning? I'd like to offer five categories for the sake of discussion: ecological process, natural resource factors, natural hazards, open space and resource production.

Ecology deals with relationships between living organisms and the air, water, and soil of their environment. Energy flow and nutrient cycles are the fundamental concepts underlying the ecologist's interest in diversity, food chains, entropy, succession, and ecosystem stability. Ideally the ecologist would offer the planner a model which could be used in a city or county to classify ecosystems, reveal the carrying capacity of each ecosystem, and suggest criteria for ecological policies. It would all be very objective, rational, and scientific. The planner would then be sure he is dealing with the environment in a holistic rather than piece-meal way and he would be "off the hook" for making arbitrary value judgements.

Unfortunately, ecologists have not come up with such a classification model, carrying capacity measurements, or criteria for ecological policies. It will be some time before the state of the art arrives at the point where energy flows and nutrient cycles will be part of a city or county land use plan. Even if scientific techniques do advance to this point, there are still economic, social, and political problems with implementing ecological policies. Energy flows and nutrient cycles are not yet established as legal grounds for upholding a police power regulation. For example even if ecosystem characteristics were well established for the life cycle of waterfowl in a given area and it were known that certain lakes and wetlands were of critical importance as nesting or wintering areas, it is questionable whether police power regulations could restrict filling, draining, or removing aquatic vegetation for that reason alone.

Nevertheless, it is possible to build into land use planning certain protection policies for ecological process, even if not in the strictly scientific and systematic way desired. For example, a shoreland ordinance recognizes the interrelationships of a water body and surrounding lands and can serve to protect water temperatures, water quality, and wildlife habitat.

The second category, natural resource factors, includes pollution of air or water, soil erosion and compaction, wildlife management, and pest or vegetation control. Most federal and state standards and programs are aimed at this category. Its parts are easier to measure and regulate although the standards and practices are not necessarily ecologically sound. Water pollution standards, for example, do not often reflect the various factors related to assimilative capacity of various aquatic ecosystems. Local plans can incorporate existing standards or adopt special standards for areas not adequately covered in state or federal standards.

A third category of environmental concern is related to hazards to health or property. Hazards can include soil movement, flooding, wind or water erosion, and air inversions. Hazards can be identified and mapped and procedures and standards can be established. To some extent, this is now being done in some counties and cities. The social justification and legal basis for this kind of environmental regulation are well established. The technical expertise is available in various agencies and private consultants so that local plans can include provisions for natural hazards.

The fourth category is open space for recreation, aesthetic, historical or scientific-educational purposes. Most plans have some provision for open space needs, although there is often a wide disparity between what is set forth in the plan and what can actually be accomplished on the ground. The term open space has been used in so many contexts in plans that it has no precise meaning. If it is to be used as a technique for accomplishing environmental objectives, its use should be clearly defined in the plan. A narrow definition would restrict its application to public lands (or candidates for public lands) which serve a clear function related to recreation, aesthetic, historical, or scientific-educational purposes. It would have to be designated on a map and given a priority in a public acquisition program.

Open space can, of course, be viewed in broader terms than given in this narrow definition. However, if it is to do anything more than reflect idle wishes, an implementation program needs to be attached to each parcel of designated land.

The fifth category of environmental concern is resource production. The resource production activities will vary from region to region, but can include agricultural land, timber land, mineral extraction sites, cranberry bogs, and fish or shellfish harvesting areas. The need for protecting these resources is well recognized, while the techniques for accomplishing such protection are not very effective. Preferential or deferred tax treatment and zoning are the principal protection techniques currently used and neither really can be counted on to achieve the objective over the long haul. Certain new techniques, such as transferable development rights and conservation easements in combination with clustering are being investigated to strengthen protection of resource lands.

Once the resource lands are identified and appropriate policies developed, serious thought needs to be given to this question of effective protection. A knowledge of the legal limits of the police power and a willingness to offer attractive incentives, perhaps utilizing new techniques, are needed to accomplish resource production goals.

In summary, natural environment concerns cover a wide spectrum of planning problems. A systematic method of integrating environmental concerns with economic and social goals needs to be articulated as part of the planning process.

Methods and techniques for establishing minimum base levels of protection and a trade-off system above the minimum base-levels also should be part of environmental planning.

Planning conceptualization has been dominated in Oregon, as elsewhere, by the use of a zoning map. In fact, it's often difficult to tell the difference between a zoning map and a plan, except the zoning ordinance tends to be more detailed.

Is there another way of doing it? Performance planning represents a somewhat different perspective.

First, a word of background is in order. In September, 1973, Oregon State University Extension Service contracted with Clatsop County, Oregon to assist them in updating their comprehensive plan. As part of this project, OSU Extension was to help the county develop a planning model which would address the problems discussed earlier.

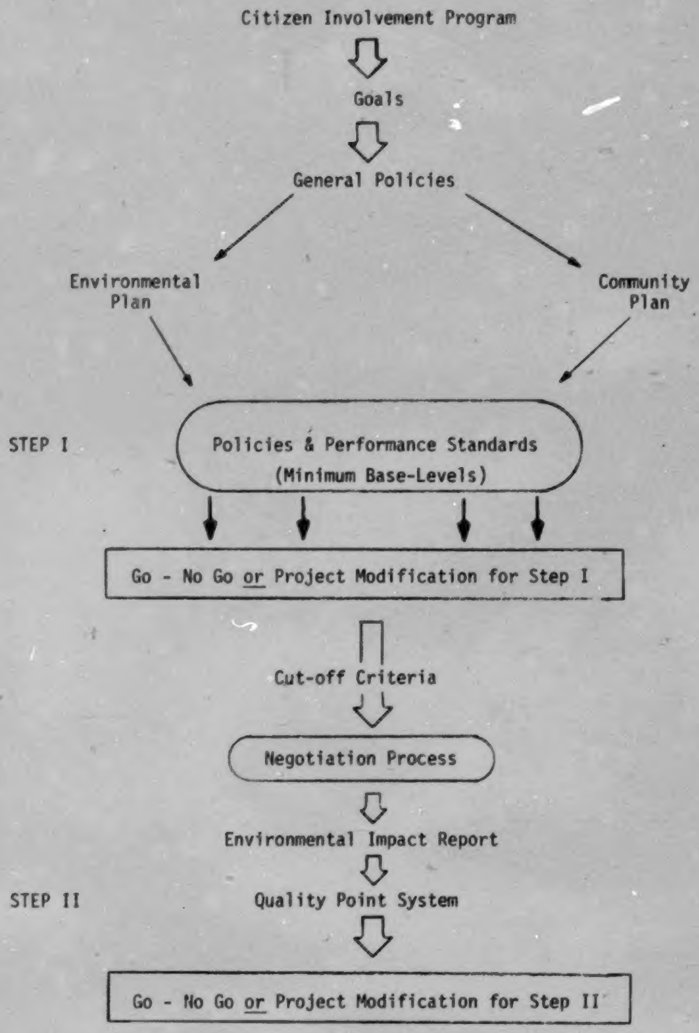
The planning model eventually developed and adopted by the county is called Performance Planning. Its focus is on measuring effects of development activities, instead of regulating uses, and evaluating the effects against desired levels of environmental and community (social-economic) characteristics. The chart on the next page illustrates the general outline of the planning model.

As can be seen from the chart, there is an Environmental Plan and a Community Plan. The Environmental Plan provides the setting for the social and economic activities covered in the Community Plan. Environmental policies are implemented by performance standards, conservation easements, a capital expenditures program, an environmental impact report, and a quality point system. Performance standards (standards based on effects of an activity which are measurable) provide minimum base-levels of environmental protection while the Step II Negotiation Process provides a structured format for evaluating certain projects expected to have major impact on the environment or the community. The Quality Point System of Step II requires a proposed project to accumulate a certain number of points, say 60 of a possible 100 total points. Points are awarded on the basis of relative impact on housing, environmental quality and community facilities. The environmental quality points are computed on a scale of 1-5 and reflect varying degrees of negative impact on open space, pollution, biological communities, unique sites, and productive natural resources.

To follow up my earlier remarks on environmental issues, I'd like to explain briefly how we organized the five categories in the Environmental Plan.

The plan is organized around four principal sections: landscape units, critical hazard areas, public open space, and priority resource areas.

PERFORMANCE PLANNING MODEL


Citizen Involvement Program
Goals
General Policies
Environmental Plan
Community Plan
STEP I
Policies & Performance Standards (Minimum Base-Levels)
Go - No Go or Project Modification for Step I
Cut-off Criteria
Negotiation Process
Environmental Impact Report
STEP II
Quality Point System
Go - No Go or Project Modification for Step II

Landscape Units - The basic idea of the landscape units is that they reflect a set of characteristics which, taken together, constitute a natural process. The soils, hydrology, biota, and landforms are interrelated as an ecological unit. Thus, environmental policies can be established to reflect overall natural processes of a landscape unit, as well as specific resource limitations. (The landscape unit section encompasses some of the concerns in the natural resource factors category as well as the ecological process category.)

Each piece of land is in a landscape unit. Twelve landscape units were identified for Clatsop County:

1. Coastal Beach
2. Dunes
3. Alluvial Lowlands
4. Alluvial Terraces
5. Marine Terraces
6. Freshwater Wetlands
7. Estuary Wetlands
8. Coast Range Foothills
9. Sedimentary Uplands
10. Basaltic Uplands
11. Headlands
12. Waterbodies and Shorelands

Once the land is classified, policies and planning actions are prepared for each landscape unit. The units also provide the framework for using environmental performance standards to reflect varying land capabilities.

Critical Hazard Areas - The second section identifies hazards to life and property, such as mass movement (soil creep, earth flow, slumping), flooding and erosion. Each type of hazard is classified into categories according to the degree of risk present. For example, the Flood Hazard category may have three classes as follows:

Class I - Seasonal high water areas
Class II - Floodplains subject to ponding from 100 year flood
Class III - Floodings which experienced heavy damage in floods and which are within the moving current of 100 year flood

Performance standards are prepared for each hazard. A permit system for building in a hazard area is necessary to monitor development.

Public Open Space - The definition of open space which we used is somewhat more restricted than most. It goes like this:

For the purposes of this plan, open space will be defined as:

> Land which is open to the sky, which serves an identifiable function by remaining as open space, and which is under public control through either public ownership, dedicated easements, or public trust. Types of public open space include aesthetic sites, recreational sites, critical wildlife habitats, and areas of scientific or historical interest.

Criteria for open space designation:

1. Must be mappable
2. Serves an identifiable function as listed under Functional Definitions of Open Space. (Described in Clatsop County Plan)
3. Requires public designation for protection as open space
4. Public need for the site must be established
5. Must be reasonable to implement within a reasonable period

The reasoning for this limited definition is that most open space plans don't get implemented because open space is used to cover too many planning objectives. In the performance planning model, open space can be achieved by other parts of the Environmental Plan and by performance standards in the Community Plan so that only public open space is included in our definition.

Priority Resource Areas - The term "priority" is used intentionally to denote an order of significance. Priority Resource Areas are defined as lands containing natural resources of either existing or potential economic value which require some form of protection in order to conserve or utilize wisely. To be designated a priority resource area, the area must serve an important economic function and be subject to loss of the resource in the absence of conservation measures. Included in the category of priority resources are: forest lands, fisheries, agricultural lands, mineral resources, and water supplies. Other resources may be added to this list.

Each priority resource area has policies and planning actions to guide decision making relative to these areas. Techniques for carrying out policy may include zoning, conservation easements, clustering, and special property assessment.

SUMMARY COMMENTS

The approach outlined in this paper represents a beginning of a performance planning process, not an established formula. It presents some ideas and procedures which can be molded and shaped to fit local conditions and planning goals.

The various parts of the Environmental Plan can be more finely tuned in time. The landscape units, for example, can be broken down into various levels of detail to better reflect complex environmental conditions affecting development. It would also be desirable to create performance standards for the landscape units which would express carrying capacity limitations of each unit. It may even be desirable to go beyond this and assign values to the landscape units, recognizing that not each unit has the same relative value. Levels of performance standards to correspond to levels of values could then be devised. These kinds of environmental performance standards, weighted to reflect varying values and devised to express carrying capacity of ecological units, will require a continuing research effort.

In order for environmental values to have a significant place in the decision making process, we need to proceed beyond rhetoric and propose methods. With a choice of methods and techniques the planner can then put together the combination which responds best to his planning needs.

THE ULTIMATE CIVICS COURSE

William R. Van Dyke

Among the materials I received in preparation for this discussion was a multi-colored brochure with the theme of the World's Fair prominently displayed on the front: "Celebrating Tomorrow's Fresh New Environment." I can't help but feel that the celebration is a little premature. While we've made some excellent initial steps in the direction of environmental protection, many of these efforts began in a time of economic prosperity and supposed energy abundance. Now that both economic prosperity and an abundance of energy are in question, there is a temptation to sacrifice environmental values. The real test of these values lies ahead, not behind. Because the real tests are before us, the question posed in this session, "How can environmental values be incorporated into decision making?" is a highly important one.

My approach to this question will draw heavily upon my experience with OSPIRG. Before I address the question, therefore, it is important that you know a little about this organization. OSPIRG stands for Oregon Student Public Interest Research Group. The research we do involves consumer and civil rights, as well as environmental issues. But, the important word is Student. Students on 15 Oregon campuses make up the board of directors which decides the policy, projects undertaken, and hires and fires staff. And students provide the person-power to carry out these projects under the supervision and advice of the ten staff members they have hired.

Early in OSPIRG's three year existence, the student board of directors decided that a major goal of the organization would be to examine the performance of government agencies and recommend changes where research showed that improvement was needed. This decision added two major tenets to the previous commitment to student participation: recommendations for change would only be based on thorough, in-depth research; and the government decision-making process would be a major focus of that research.

Today, the student who participates in OSPIRG research gets more than just a chance to press for more equitable consideration of environmental values -- or

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William R. Van Dyke is a staff member of the Oregon Student Public Interest Research Group (OSPIRG) in Portland, where he directs student research as well as carrying out his own research in government agency policies; for example, those relating to highways, pesticides, reforestation, and parking.

consumer and civil rights values -- in government decisions. He or she also participates in an intensely educational process which might be termed, "The Ultimate Civics Course." In the process of his research, the student closely scrutinizes and analyzes the actions of government. Upon completion of the research, he often becomes involved in the governmental decision-making machinery as he tries to achieve adoption of his recommendations for change.

My answer to the question posed for this session is this: more people-- not just students -- must participate in that Ultimate Civics Course. Environmental values will only be reflected in the decisions of government when the public actively makes it clear that it desires these values. To illustrate how this involvement can work, I will briefly look at some examples of OSPIRG's participation in three steps of the decision-making process: legislation, standard setting by administrative agencies, and enforcement of established standards.

OSPIRG's full participation in the legislative arena is limited by a tax status which prevents any substantial lobbying. Nevertheless, OSPIRG research has played an important part in some legislative decisions. The issue of Cape Kiwanda is one example of this importance.

Cape Kiwanda is a virtually unique area of sandstone formation on the Oregon coast, one that has been widely acknowledged as a natural wonder. The Cape itself was formed as a result of a large off-shore rock which protected the sandstone on shore from the ravages of the sea for thousands of years. Unlike most of the Oregon coast, this area was privately owned. While the owner had maintained the area in its natural state, he experienced increasing difficulty in meeting tax payments on the land. In 1972, he offered to sell the Cape and some surrounding land to the state as a park. The State Transportation Commission turned him down. The Commission claimed that a number of personal injury accidents resulting from falls from high cliffs on the land rendered the area unsuitable as a park. In late 1972, a private utility announced that it had purchased options on the land, and was considering construction of a nuclear power plant north of the Cape.

OSPIRG's study of the area found that the Cape was in fact a unique natural formation. Moreover, through comparison to the structures of other nuclear plants, the study demonstrated that it would be virtually impossible to hide the visual presence of the plant facilities. They would inevitably obtrude upon the natural beauty of the area from many vantage points. Finally, OSPIRG discovered that most of the personal injury accidents had occurred in one isolated area which could be easily fenced. As a result of this study, OSPIRG disputed the findings of the Transportation Commission and recommended state purchase of the land as a park.

As a result of the findings in this report, the state legislature passed a resolution expressing its sense that the Cape should be acquired by the state. This resolution, together with publicity which followed disseminatiom of OSPIRG's report and presentation of findings to the press, generated pressure on the private utility to abandon its plans. In mid-1973, the utility's options expired. After some negotiation with the owner, the State Transportation Commission purchased the Cape for use as a park.

It took the intervention of a private group to demonstrate the environmental value of Cape Kiwanda, to dramatize the fact that it was endangered by private development, and to discover that the major Transportation Commission objection to acquisition of the land could easily be remedied by fencing an isolated section of the land.

Administrative policy or standard setting has been the area of greatest focus for OSPIRG's environmental efforts. Our most recent proposal in this area deals with air quality standards.

The Environmental Protection Agency has already required that certain air quality standards be met nationwide. The main problem areas in meeting these standards have been metropolitan areas. As a result of a court suit, the EPA was directed two years ago to establish policies for "non-degradation" of air in areas which exhibit less pollution than this first set of guidelines would allow.

In the fall of 1973, the EPA took testimony from the states on non-degradation policy. In the name of the Governor, the Oregon Department of Environmental Quality suggested fairly strict guidelines. These guidelines would have allowed states to designate areas as especially important for preservation of air quality. Any facilities constructed in these areas would be required to meet certain pollutant standards.

The EPA has now proposed its guidelines of non-degradation. These are far less strict than the proposal urged by the Oregon environmental agency. Moreover, while the Oregon Department of Environmental Quality has authority under state law to establish such standards, it has not followed its own advice to the EPA. To date, no standards have been adopted to insure non-degradation of air quality in the more pristine areas of Oregon.

OSPIRG has formally proposed regulations to insure maintenance of pristine air quality. With certain modifications, this proposal is identical to the advice given the EPA over a year ago by the State of Oregon. OSPIRG, however, has actually called for designation of National Forests and Parks as specially regulated areas. In addition, the proposal would require monitoring of air quality in any pristine areas for fifteen months prior to construction of any facility which would emit certain pollutants. Any facility constructed would then be required to control pollutants so as not to reduce air quality below a certain level.

Under state law, the Department of Environmental Quality must react to these proposed regulations within thirty days. Again, the prodding of a private group has been necessary to force action by state government on an environmental problem.

Environmental standards must, of course, be enforced to be effective. Without good enforcement, successful efforts to gain adaption of environmentally sound standards become empty victories. OSPIRG is also involved in work to insure that environmental standards will be enforced.

During the summer of 1974, an OSPIRG student intern compiled a handbook on water quality. The book tells citizens how they can analyze water pollutant discharge permits to determine if permits have been validly written by the State Department of Environmental Quality. The handbook also details procedures for challenging these permits if they are less than adequate.

As a second part of this project, OSPIRG has organized students to determine if permits already issued are being complied with. Throughout the state this fall, students from a number of colleges and universities have been patrolling certain rivers on weekends. Discharges and dumping into each river are carefully recorded, and samples of discharges are taken for analysis. Using this information, students then check Department of Environmental Quality files to determine if permits have been issued to allow dumping or discharges they have found. In cases where discharges are allowed students also compare analysis of the discharge to levels of pollutants which the permit allows. Violations of any permits will be brought to the attention of the Department of Environmental Quality. Students will then monitor any actions of the environmental agency to bring violators into compliance with their permits.

In pressing for consideration of environmental values, we have found several state laws extremely helpful. Oregon has a recent public information law which requires disclosure of government information except in specifically limited cases. A new public open meetings law requires that meetings on most public policy decisions - aside from hiring and firing of personnel - be open to the public with adequate notice to the public. An administrative petition law requires state government agencies to react to rules proposed by any group with legal standing within thirty days. This last law allowed OSPIRG to propose the air quality standards I mentioned earlier.

University and college faculty members have provided support for OSPIRG's research. Some instructors have allowed credit for OSPIRG projects. Others with expertise in areas OSPIRG has researched have served as excellent resources for that work.

OSPIRG has researched many areas in addition to those I have mentioned: the use of DDT on tussock moth infestations, the removal of prime farm land from agricultural production, and statewide land use planning to name a few. The examples I have detailed here are, however, representative of OSPIRG's total experience with public decision making. This experience illustrates that action by private citizens can be highly effective in urging consideration of environmental values. More importantly, our experience shows that these values may be considered barely, if at all, without citizen action.

Citizen action is needed at all levels of decision making: legislative, administrative policy setting, and enforcement. Projects like Cape Kiwanda and the air quality proposal are designed to induce action where government is reluctant to act. Projects such as the water quality handbook and river monitoring are designed to hold government accountable for its decisions when it does act. This is the focus of The Ultimate Civics Course.

The OSPIRG experience provides several guides for those who want to increase the importance of environmental values in decisions that are made. The first civics lesson: there is no substitute for solid factual research to back up arguments for these values. OSPIRG's impact on decisions has clearly increased as it has built a reputation for credible research. Second, it must be clear to decision makers that there is wide support for the course of action being argued. OSPIRG has the support of students on 15 different campuses in the state. It achieves even broader public support by disseminating the results of its research through releases to the news media. Finally, people in states lacking laws which open the decision-making process to the public must begin pressing for public information, public open meeting and administrative petition laws such as those I have described. These laws are, of course, not immediately environmental issues. But without them, the public lacks access to the decision-making process. Without this access, the difficulty of pressing for consideration of environmental values is multiplied many times. This is perhaps the most important lesson in The Ultimate Civics Course.

Participation in The Ultimate Civics Course can be exciting and rewarding experience. I would be dishonest if I did not also say it can sometimes be a frustrating experience. But above all, it is an important undertaking. Without wider public interest in government's decisions, "Tomorrow's Fresh New Environment" is an unachievable dream.

ENVIRONMENTAL VALUES AND DECISION MAKING

Kai N. Lee

In talking today about the incorporation of environmental values in public decision making, I shall take it for granted that the decision making processes as we know them are elite processes. That is not, of course, to say that the feelings of the general public are unimportant, or even that they are not taken into account. But there can be no doubt that environmental values have been articulated in recent years primarily by members of what is, by any historical political standard, a special interest group. I say that not to denigrate the environmental movement--certainly the results that have been achieved by environmentalists are far out of proportion even to the intensity of their own, often passionate, feelings. Yet it is important to remember that environmental politics has, over the past several years, become a subsector of "politics as usual." This elite or "politics as usual" emphasis, however, sets some interesting and important limits on the kinds of values which are articulated and then incorporated into the decision-making process.

Therefore, rather than rehearsing with you the positions normally taken by environmentalists as they confront government decision makers, it seems to me useful to try to place some of these claims in a broader, though still elite perspective. To do that, I'd like to share with you some of the thoughts of three writers: Laurence Tribe (1) is an attorney with a mathematical background, who now teaches at the Harvard Law School; Robert Socolow (2) is a physicist who now teaches environmental studies at Princeton; and Robert Heilbroner (3) is well known to many of you as an economist whose most recent book, An Inquiry into the Human Prospect, has gained wide attention. What these men share is an uncommonly broad perspective on the nature of the environmental problems which we face. I'd like to use their ideas today to suggest the kinds of questions we should raise about the incorporation of values into decision making processes, particularly the decision-making processes that we're faced with in the United States.

But to start off with, I'd like to give you an excerpt from a speech that was given here in Spokane on August 15th (4). It was originally to be given by Vice

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President Gerald Ford, but by August 15th he was no longer Vice President, and was detained in Washington on what his predecessor called "the people's business." Mr. Ford's speech was read for him by Interior Secretary Rogers Morton. In that speech, Mr. Morton said, "there are some well-meaning people who see the environmental issue as an 'either/or' proposition. They would make the environment the over-*riding consideration in all our activities, regardless of the consequences*, regardless of the sound, middle-ground alternatives that might be worked out...I respect those views and the people who hold them. But will they please explain, under a zero growth philosophy, how we can provide the jobs required...We must generate 17 million new jobs in the next decade. How are we going to do it without vigorous economic growth? How do we rebuild our cities, modernize our transportation system and provide better health facilities for our people, without the funds that growth produces? How do we generate the revenue to meet the growing claims upon government for expanded public services? And how do we pay for the environmental enhancement envisioned in programs already underway? The cost to government and industry will reach $275 billion dollars during the next decade. Where is the money coming from, except through economic growth and the productivity increases that help to provide it?"

The President's words reflect a set of thoughts which have been heard far and wide, particularly in recent months, as the energy shortage has provided a public issue which can be brought to bear against the pleas of environmental advocates. That theme is that environmental concerns are not the only concerns to be met by public agencies. Accordingly, environmental values are not by any means well entrenched, particularly now at the national government level. As one moves from state to state, there is also a great deal of variation among the different states. Hence, the need for continued pressure by that group of people who have specialized in the past on the advocacy of environmental values--the environmentalists. Without that pressure, it is likely that environmental programs would, in many cases, wither away.

In addition, it is most important that we realize that opponents of the environmental movement have some strong values of their own to defend. The next paragraph of Mr. Ford's speech began, "Man isn't built to vegetate or stagnate. We like to progress." Of course, the President's invocation of progress here was meant specifically to take issue with the philosophy of no growth. And the response of those who advocate a slowing of our growth rate would surely be that progress has become, in this advanced society, a goal of many dimensions; that is, that progress need not come only in the form of economic expansion. But if progress is to have a non-economic component as well, what should this component look like?

In 1972 highway officials in Los Angeles County decided to install nearly 1,000 plastic trees along the side of a freeway. They had been impelled to do this by the fact that new construction had left too narrow a strip of dirt by the side of the road to sustain natural plants. Moreover, it seemed likely that no natural trees would be able to survive in the smog-laden atmosphere next to the freeway. Shortly after the trees were installed (it hardly seems fair to say "planted") a number of unknown, but presumably irate citizens came by at night and stole several of the plastic trees. Some others, wittier but presumably no less irate, installed plastic birds in the plastic trees. The combination of vandalism and ridicule proved quite persuasive to Los Angeles County officials and the plastic trees program was summarily halted.

The symbolic--that is, value-laden--impact of the plastic trees decision has so far sufficed to fuel two scholarly articles. The first of these was written by my former colleague Martin Krieger, a planner who now teaches at the University of Minnesota. In an article entitled "What's Wrong With Plastic Trees?" Krieger noted that "the demand for rare environments is...learned." This means that "conscious public choice can manipulate this learning so that the environments which people learn to use and want reflect environments that are likely to be available at a low cost." (5) Krieger's bold statement of this position (which is rather more common than we suppose, I think) inspired in turn Laurence Tribe's "Ways Not to Think About Plastic Trees" which I shall turn to in a few minutes. What is germane here is that we would do well to consider in addition to the idea of (one-dimensional) progress, the notion that human beings are, after all, quite adaptable. Thus, although we have only one earth in which to live, there may be many millions of ways in which the people who live on that earth can learn to live with whatever state the environment is in. Between progress and adaptability, we have two sets of important values which stand, at least partially, in opposition to some rather deeply held positions of anyone who would count himself an environmentalist.

I think it is clear that analyzing the fundamental value conflicts that are embodied in these issues is an enterprise which complements the more pragmatic concerns that Bill Van Dyke and Jim Pease have shared with us already in this panel. What I should like to propose is that we consider two approaches to the question of values. The first of these is the analysis of what Robert Socolow has called "failures of discourse." That is, Socolow argues that environmental conflicts are, in significant respects, failures of communication rather than fundamental conflicts. He offers us the hope, then, that environmental value conflicts may be "dissolved"; that they may be resolved in freer communication. The second approach is that of Laurence Tribe, namely the idea that in the environmental ethic we may find at least the beginning of a religious restoration in our society, the restoration of religious values. Certainly, the idea that Nature is in some respects holy is not a totally foreign one.

Although environmental conflicts are undoubtedly complicated by communications problems, Socolow's notion of a failure of discourse is meant to describe something deeper than a mere misunderstanding. A failure of discourse involves a set of habitual attitudes toward natural things, and also a set of habitual attitudes toward the decision making process. In order to change them, it is not enough simply to say, "Well, we are reasonable people, we can reason this through." That something more than an appeal to reason is involved is important, at least tactically. For example, one of the speakers this morning was a state official, who appealed to university people to maintain their credibility in the public arena. He meant by credibility technical skill. Yet I believe it important to keep in mind that credibility is first of all a political quantity; just because one is technically correct does not mean that what one says is credible. Believability is not an entirely rational matter.

Socolow discusses four failures of discourse, all of which are interesting for those of you who are involved in negotiation over environmental projects. The first failure of discourse is that of technical credibility: quantitative data are very often discredited. If the "experts" disagree--as they often do in environmental cases--there can rapidly come to be mistrust and squabbling over facts which are really quite elemental. That is, even facts which, in other settings, all the disputants would agree to suddenly turn out to be up for grabs.

A related challenge to technical judgement is the failure of discourse which develops when numbers become constraints. Often, empirically based numbers are adopted within regulations or legislation. Once this happens, the numbers are, in effect, frozen. They become non-negotiable items which serve to bind future discussion. Perhaps the clearest case is the standards adopted in the Clean Air Act of 1970. In the case of the clean air standards, performance limits for automotive engines were set on the basis of slight, probably insufficient technical research. Yet the point is not that technical analysis was done badly by the Congress, but rather that the existence of definite, and definitive, standards serves as a barrier of enormous political significance to both auto makers and environmentalists on preserving these standards. Conversely, environmentalists often have an opportunity to invest an environmental conflict with a kind of flexibility that is rare indeed. They can find this flexibility in seeking to reopen a technical discussion about the appropriate numerical standard to be set. By and large, this opportunity is forgone in the heat of advocacy.

A third failure of discourse that Socolow identifies is that the ecological ideas that are used in decision making are often extremely primitive. Indeed, a major thrust of the environmental movement over the last several years has been to encourage the hiring of professionally trained ecological biologists in the staffs of agencies, both public and private, charged with environment-altering responsibilities. To some extent, then, the problem of ecological primitivity is being overcome. But there is a political side to this as well. Environmentalists--as distinguished from ecologists--are very often in the business of opposing a project backed by powerful interests. Yet the environmentalists have few resources: generally, they have very little money; they have weak organizations. Frequently, the only thing environmentalists can do is to use scientific facts--couched in ecological language--in a way that tends to cast a pall of uncertainty over the project, and that provide a rhetorical opening for the raising of all kinds of concerns, both ecological and social. This is a very important and very useful tactic. Socolow's point, and it is one with which few would disagree, is that this tactic has its limits; I note here only that it also has its uses.

As in the case of a (deliberately) oversimplified ecology, Socolow's fourth failure of discourse points towards a political response to unequally distributed powers and resources. As he and others have noted, proponents and opponents of a given project will often have in mind very different images of the future. These different images lead, in turn, to different operational expectations about the consequences of proceeding with the project. When this is true, the addition of ostensibly value-neutral facts can often destablize a consensus, or worsen a disagreement. Yet, it remains extremely difficult to articulate the differences in the futures envisioned. For in a dispute, knowledge is power. To talk articulately about the future one foresees is to talk as well about what one truly wants. Certainly many a bruised proponent of projects over the past few years must have wished that he knew what his opponents "really" wanted. That begins to suggest the power inherent in denying or at least obscuring one's true intent.

In sum, the idea of a failure of discourse is one which helps to organize a great deal of our intuitive understanding and experience of environmental disputes. Nonetheless, I think it important to keep in mind that the word "failure" here sometimes points too to successes, cases in which environmentalists have converted obstruction into political power in the making of decisions. One has the feeling, however, that the virtues of obstruction will not last forever for the environmental movement. It is an interesting, and unanswered, question when obstruction will have lost its efficacy.

Let me turn now to the second approach to the question of values, the concern for the rediscovery of religious values that may be inherent in environmental decision making. In his critique of Krieger's argument in favor of plastic trees, Laurence Tribe cites a passage from the philosopher David Hume's Treatise on Human Nature. It bears repeating here, and if you listen to it closely it sounds rather peculiar. David Hume said in the eighteenth century, "Reason is and ought only to be the slave of the passions." What Hume meant was that our preferences, our values, are in an important sense beyond the powers of our reason to determine. In turn, our reasoning powers should be subservient to the essentially irrational values that we possess. Yet it is not clear any longer that we can regard our individual preferences as simply the givens of our political system. It is no longer clear, in other words, that governments, and agencies, are only the passive reactants to public opinion. This is true partly because public opinion--the passions to which government ought to be the slave--has become a rather elusive matter, especially on environmental affairs. But it is also that the future has become increasingly important to matters of current public policy making. The difficulty is simply this; where are the values of the future to come from? And how can we find them in today's world? The difficulty that Tribe raises for us is that our whole conception of rationality has been shaped by David Hume and the kinds of thought that he pioneered. Hence, if we are to try to find a way for reason to be the slave of the passions, we are faced with some rather sizeable difficulties at the conceptual level. That is, we are faced with difficulties in not knowing how to think about some of these issues. Is it, for example, clear that more _thinking_ can tell us something about future values? More troubling, if we could _know_ something about future values, what kind of knowledge would that be? Obviously, philosophy has some rather practical and immediate consequences, here at least.

Despite his philosophical interests, however, Tribe is in the end an attorney. He points the way out of this tangle of future values and present decisions through an interesting, if somewhat flawed route. Tribe argues that the environmental movement represents far more than the emergence of a new interest group, concerned about the preservation of hiking trails and other upper-middle-class amenities. Rather, he sees in the environmental movement the development of a different attitude toward nature. It is an attitude which he calls ethical: "Even the seemingly innocuous act of supplementing the inadequacies of nature with human artifacts--erecting plastic trees...--may transgress the imperatives of an emerging environmental ethic. Plastic trees implicitly reduce the entities they portray to terms of servicability, utility and adornment. And such caricatures in turn reinforce the belief that the depicted objects exist not for themselves but only to serve superior needs." The environmental ethic, then, is one which asserts the _independent_ ethical validity of the natural world for itself.

Tribe's is the position of the committed ecologist. Man is part of nature, nature is not merely part of the man's ambitions and uses of resources. The flaw I find in such a position is not one of principle, but rather one of practice. For decisions remain, irrevocably, in human hands, and they are inescapably the expression of human values. It is for this reason that a substantive--rather than ethical--aspect of the environmental cause may turn out to be far more influential on the course of decision making, and the values manifested in those decisions, than the ecologist-ethic which Tribe argues for. In the end, the environmental value that counts is an end to growth.

It is by now well known that the great magic of growth is the "trickle down" effect. As the economy grows, more of the growth can be given to those at the bottom of the economic ladder than to those who are at the top. In periods of no overall growth, the enriching of the poor can only come from the impoverishing of the rich. The magnitude of the effect here has been estimated by Robert Heilbroner in his new book An Inquiry Into the Human Prospect. Heilbroner estimates that short-term no growth, in combination with a program of redistributive social justice, would lead to deprivations of people in the middle classes of our present society. He argues that in order to achieve minimal social justice, those making over $15,000 a year would have to be deprived by something on the order of 40 to 50% of their incomes. I should guess that nearly all environmentalists fall into this socio-economic class. I trust that you will make your own calculations about the kind of deprivation that a 40 to 50% cut in income would amount to. To be sure, this kind of redistribution is the sort that would lead to far more equitable, though still extremely small shares for most of the people in the Third World. Such redistribution, it seems to me, is far from likely given our present political climate.

Yet I believe there is no gainsaying Heilbroner's long term predictions that hectic growth, particularly the economic growth of the twentieth century, simply cannot be the permanent future of the world. It cannot even be the future of America. The recognition of that fact, in its everyday manifestations, is what we call the environmental movement.

What kind of society, then, is envisaged by following through with these environmental values? Heilbroner uses the word "stoic" to describe the world that he sees coming in the distant future. It is a sobering word. What we should find troubling about stoicism, of course, is not that stoicism is, at the individual level, a value not worth sharing. Far from it. The difficulty lies in envisioning the development of a collective sense of stoicism. How, if at all, can we move to a social and a cultural appreciation of the environment in which we live? Here, Tribe's environmental ethic seems more and more apt as we realize the limits of our own ability to grow. Yet the key question is the social one: can we, as a nation, as a world, come to hold this kind of ethic? If we can, I believe the incorporation of environmental values into decision making will be a rather trivial issue. It will happen as a matter of course. If this collective stoicism is not possible to achieve, however, the historic commitment to progress, and the perhaps too easy confidence in human adaptibility, may leave us with a society which is not stoic, but only mean, only unjust in its meanness.

Thus, the issue of environmental values and their place in decision making is linked with surprising immediacy to the political problems of fashioning a habitable, perhaps even just future. It is a connection that I think lies at the heart of what needs to be taught in environmental education.

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DISCUSSION

Question: Would it be possible to tie tax incentives to some of the goals that communities have, perhaps in a much more positive way? You spoke of not having much that could be done except zoning. Tax incentives, tax credits for certain kinds of things, tax penalties for other kinds of things, ways to get land that was misused into some other form of use which we want--have you considered them? Or are there reasons why you can't do that?

Pease: I'm interested in that topic. It's a complex topic and one that we didn't have a chance to get into much in this particular project. There are some people investigating that, and perhaps the largest project is a $2,000,000 a year project at UCLA entitled "Windfalls and Wipeouts". They started the project last September, and they have a progress report they put out in April. Then they have an annotated bibliography which came out in July. This is one of the main things they're lookinq at, as well as some other techniques, like transferrable development rights. There are a variety of techniques available. But right now they all seem to be just in the incipient stage, and it's difficult to pick out five tax incentive programs and shape them up in a form that an unsophisticated county can use without stirring up all kinds of problems. It's hard enough just conveying the idea of performance standards, something a little different.

But I agree that there are a lot of things that can be done. Some of the things the UCLA study is looking at include traditional assessments--should a new development be required to pay its own freight for any kind of public facilities that are provided? We used to use that technique pretty commonly back in the 30's and 40's, but we've gotten away from it more and more recently. Now we require bonds of a developer to agree that he's going to dedicate a road and put certain facilities in his development, and so forth.

But the idea of a special assessment, perhaps a tax attached to the number of bedrooms in the development, would get at what is probably the most expensive problem associated with development, and that is the support of public schools.. That sort of thing has been done before. You could treat residential developments like a business, and have some variation of a business tax, some formula

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Alice Shorett, Public Service Coordinator at the Institute for Environmental Studies, University of Washington, moderated Session 19.

for applying this to various kinds of development. That would reflect your community goals. Now if those goals were low income housing, or if they included clustered housing instead of scattered, single family housing, some kind of tax could tie those in. That project is investigating those kinds of questions. There are a couple of researchers on the extension staff in economics who are also looking at the relationship of taxes and land use policies. So I think it will be something that we can turn to in a couple more years, and then have some concrete tax incentive proposals that we can implement at the local level.

Question: I'd like to go back to the point about passions versus facts. It strikes me that decision making normally is a process more of passion and rightfully so. The process Jim talked about, for example, is founded on something called ecological values which are really more ecological principles. I've always been confused about how those principles work to determine values, because as I have observed the decision-making process, there is no set of consistent values that are equally weighted across the board. The decision is always a situation in which there are tradeoffs among all kinds of conflicting values which people have to weight. The strongest environmentalist might weight environmental values or principles very low when some personal interest like his job, or losing his house, or his family's health is at stake as a tradeoff against preserving some stream in its natural condition. How can we relate these values or these passions to the kinds of principles that a technical specialist wants to use to decide the "right" use of resources? Basically, he's setting standards for resource use, which are based on some principles. Now, if I don't like those, am I wrong? Or am I mad at environmentalists? Or what?

Lee: My first response is to say that decisions are normally made within contexts and in particular situations that don't repeat themselves very well. And if there is a way to sort out environmentalists in a situation, it is that consistently they will take the point of view that environmental values, or the sorts of things that Jim was talking about before, ecological processes and harmony and that sort of thing, come near the top of their lists.

Indeed, one of the biggest problems in environmental decision making, or decision making that affects the environment, is for an environmentalist to try to steer a path through the rather narrow ground of, on the one hand, having some sort of private concern that gives him a place from which to stand and say, "No, you shouldn't do that because I care about this part of it and it will affect me adversely", and, on the other hand, the very diffuse nature of a lot of environmental concerns. There are people that have great passions about parts of nature that they will never see personally, that they will never experience--as when you lobby to have a great tract of land declared a wilderness. What you've done is point to an important set of confusions within our culture. We don't know very much about where to draw the line between a principle and a value and a standard and so on.

So, part of my response is that making that clear is not our task, certainly not this afternoon, but also that it may be misleading to think that clarity will help in that direction. Things are very unclear, and what one needs is a kind of personal strength, hopefully augmented by organizational strength and augmented by the kinds of rules that Jim Pease is designing or that Bill Van Dyke uses, like public disclosure laws. I don't know that there's any general principle that would help us to clarify it, or that even if it were clarified that would help us to act.

Question: I think it's a little more important to clarify it than you say, because what happens in not clarifying the difference between passion and principle is that planners insert themselves and their passionate values into a process of planning which is basically technical. In that process they often make many social desirability, i.e. passion-type, decisions by applying their own personal values in the day-to-day process of planning, thereby foreclosing all kinds of options on the one hand and basically just skewing the process in a certain direction. This is what the Corps of Engineers is always accused of, exerting certain organizational and personal values, engineering values.

I as a forester was trained to accept without question certain principles which became my personal values. It's good to do something because that's what foresters do, so it must be good. And so one of the problems that we have in any kind of public works planning crew, for example, is that planners don't differentiate between the application of their own values, their personal values, their passion values and the application of their principles. They mush them all together, so that doing what Jim is doing is good, and it's the right thing, and it's the best thing for society. And when you question him on this and say, "Look, you should be providing information for people to make decisions", he says, "Well, I'm a people, too. I have values. My values are as good as anybody else's values." I think one of the biggest problems in planning is that planners don't clearly differentiate themselves as individual people with passions from their role as experts with principles to apply to a problem. I know it's difficult to separate those roles, but it's extremely important to be cognizant of them, and I don't think that planners are.

Lee: I certainly would disagree with nothing that you just said. I think that ultimately there may not be a way to make that separation. But that doesn't mean that we forget about the problem. That means we have to pay more attention to it.

Question: And one final point. I don't know what you mean by environmental decisions, because it seems to me that the decisions are, should we build this street four lanes or six lanes? Should we tear down this hotel? There is really no such thing as an environmental decision--there are decisions with environmental implications. But those decisions also have all kinds of other implications.

I get disturbed by talk like that because it doesn't help people understand the system they're working in. The decisions aren't environmental decisions, and there are a lot of people with a lot of values that are just as important as yours or mine who have a right to express their views. And if they're for development and you're not, why that doesn't make them bad or insidious people. When we use terms like "environmental decisions" it helps, maybe, to bring environmentalists together, but I don't think it helps getting public decisions made any better, because then we tend to think of decisions as our turf.

Question: Who establishes what factors get considered in any given situation, and then who weights them in the quality point system? And whose weights are predominant if there is a conflict? How does that system work?

Pease: Let me just back up for a minute and say that I agree, that one of the things that I'm concerned about is that the plan is there in principle. And the other problem is, who's a planner? Everybody's a planner. They come to us from almost every discipline imaginable. The planners themselves have very little in common, so when we talk about principles for planning, there aren't very many that all planners subscribe to. One of my interests in planning in the natural resource area is to try to establish some set of principles, some framework that is defensible, that's based on theory, or on ecological principles, or on specific hazards that we can prove. It's based on data and as much as possible, narrowed down, where we have to make that kind of value decision. I don't think you can do planning without making value judgments, strictly on the basis of data and principle.

Now, in our situation, to answer your question, the citizen advisory committees, who are the spokesmen for the citizens in their areas, set the general goals. Those goals could have a development tone to them, be predominantly concerned with employment, jobs, raising land values through various kinds of developments. Or they can be very much concerned with preserving existing kinds of amenities in their area. But in any case, that has implications for what kind of planning policies come out.

So, first of all, they set the goals. The points that are assigned to various items in the quality point system reflect those values that the citizens have determined.

Shorett: Who makes the list of points in the quality point system? Who determines what actually goes on the list?

Pease: That has to be done, at least in this situation, by the planning department. They're the ones who are supposed to be on top of what the issues and problems are in their county. If low income housing, for example, is not an issue in Clatsop County, then that's reflected in the quality point system. If it is a significant problem that's supported by data, for example, we know that 50 percent of the people have incomes that are less than $6500, and a certain percentage of the housing is substandard, then we know we need better, low income housing. Then there is data to support a value point assigned to that in the quality point system.

But there may be other things. When you get into environmental quality, you have to deal with preservation of wildlife habitats. That's a tough one. Is that a value judgment? Or can we go back and draw up an ecological principle that says, it's important to the health of the total system that we preserve six wetlands in a class of plains? And then we can describe all the functions that can occur in that wetland. Then somebody else can say, "There's plenty of other wetlands. Let's fill it in."

Question: But that's the rub. You're in the situation now where somebody is going to make a decision about what to do with those wetlands, and some abstract set of goals, no matter who developed them or whether they were developed yesterday or today, can't be applied directly to the decision about those 27 acres of wetlands, because the tradeoffs on that are very specific to that situation.

There's an interesting parallel with a burning policy on wild lands in the Grand Tetons. They just let natural fires burn. There are a lot of people in that area who don't like to look at the scars. They're putting a lot of political, passion pressure on Interior Secretary Morton to change that policy. They don't care about the ecosystem, and whether it's good for it to burn or not. You can't even talk to them about it, because all they know is when they look out their window they see a big, black scar where a nice, green forest used to be. That's the nature of the decision-making process, and there isn't any way you'll ever convince them that they're better off with a nice, healthy ecosystem, even with a big, black scar.

Pease: I think it can be argued that there isn't any set of ecological principles in the abstract, apart from their value to man.

Question: That's the point--it disturbs me, because if you say there has to be a total of 100 points and you as the planner are deciding which factors to consider and then which weights to put on those points, you're deciding what things really are important. More important than what? And who are you or who am I as a planner to decide that housing is the most important thing?

Pease: Let me just explain one other thing. We have to get at this question of who's going to make the value judgment. My perspective on this is that the people who are being planned for ought to make the value judgments as much as possible, on the basis of informed judgments. We make some effort to make them aware of what the various issues are, and what the alternatives are, and then it's up to them to make the judgments on it. To me, that isn't having the planner do it, laying it on them.

As much as possible, where there are facts and data that can support a given policy, that's laid out on the table and people can understand it. But there are lots of other areas that are more fuzzy, where somebody has to make a value judgment. The way we went about it was, those value judgments are made by the citizen advisory committees.

First they start with the general goals, which at least get you pointed in the right direction as far as what they're thinking. And then that's focused down on a policy. Policy we could call criteria, if we wanted to. One of the things that I've been hollering about for quite a long time is that we need criteria that we can evaluate our decisions against, whether they're economic criteria or ecological criteria. Maybe the criteria will change next week, but we need to set them down right now, so that we can make decisions tomorrow and we know what we're evaluating against. The policies that we're using in that project could in a sense be called criteria, they're specific. Now, if we're talking about preservation of wetlands in the quality point system, that is based on a policy that the county has adopted, protection of certain kinds of wetlands. We might call that a criterion. That's stated in policy. It's not something out of thin air. And that policy is arrived at by going through the process of the citizen advisory committee, the policy advisory committee of elected and collected officials, the planning commission, and has to be adopted.

In Oregon, once a policy is adopted in a plan, every decision has to be consistent with that policy. If later on you make a decision that's inconsistent with that policy, you can be hauled into court and your decision thrown out. That's what the law says. So these policies become the whole foundation for ordinances, zoning ordinances or any kind of land use decision that's made later on.

Van Dyke: I wanted to comment on something that Jim just said, because I think you're painting the whole process of planning and the importance of policy as a little more solidly fixed in Oregon than it really is. There is virtually no plan I have ever seen or know of that doesn't have some parts in it that might contradict other parts. Some value judgments still have to be made after that plan is set forth. So you can say that a decision has to be congruent with a policy plan adopted by a county, but within each one of these plans there are some contradictory values. The case I'm closest to is Portland, because I sit on one of these citizen advisory committees to the downtown plan of Portland, and the fact is, it's just like the Bible. You can prove anything you want to with that policy plan. And it's happened time and again. Before we had the plan, virtually every development that came up was approved, no matter what was said about the guideline plan. Now we have a full staff of planners that go through and analyze it in terms of the downtown plan, and the city council still goes ahead and approves virtually every development that comes up. But we do have a plan. So I think that you're placing a little too much importance on that law because there are contradictions in almost every plan I've ever seen.

Pease: That's true, but nevertheless the Supreme Court of Oregon has ruled that policies set forth in the plan have to be the basis for ordinances and quasi-official decisions that are made by planning commissions or elected officials.

And secondly, the state law says in a planning act that passed in 1973, Senate Bill 100, that the plan, the policies in the plan are the legal base for ordinances, and judicial decisions that are made on that.

Thirdly, I think that Portland isn't representative of Oregon in planning.

Shorett: Kai, I was disturbed as you talked about the problem of cognitive distance and the fact that people have differing images of the future, and also the fact that you foresee different sets of elites going after one another. What do you see for any reasonable discussion of values? What are we in for? Are there any things we might attempt to do?

Lee: There are a number of things. We first should distinguish between the short term and the longer term. The longer term looks pretty uncertain, and one can see that it looks pretty bad in the sense that there are these longer term resource restraints which will show up probably economically rather than as absolute limits to development, but they will show up in real forms.

In the short term I think it's important that the environmental movement, people who consider themselves environmentalists, first realize the extent to which they have in a very short order become a force to be contended with in American politics and in the routines of decision making. The success of organizations like OSPIRG and many other public interest organizations that have to do with the environment has led to a lot of progress and a lot of changes in substantive ways. So we are already talking to each other about environmental values.

There are a lot of other values which have not yet shown up very effectively; the welfare rights kind of stance is something that hasn't been taken seriously yet. And the conservation people who've been in the environmental movement since the beginning or since a long time ago will tell you that there were long periods of time when they were just totally ignored. So I think there is quite a bit of hope in the short term.

There is also a place that has been surprisingly underemphasized here for universities that do research related to environmental matters, generally environmental science and technology, and also environmental policies, policies that have environmental implications (to accept that clarification which I think is a useful one). It's very important that universities make their findings much more visible than they are now, particularly to citizens who are in search of, let me call it relatively less biased information. I think it's unfair to call it unbiased. But there is another point of view. Universities, particularly state universities that are dependent upon the legislature for approval and funding and that sort of thing, have an affirmative responsibility to serve as a channel for the wishes of the public, for articulating the kinds of things that various groups of citizens feel. By various groups of citizens I would include lots of groups that are not very positively inclined toward environmental values, from agriculturalists to industrialists to labor union interests in cities. And I think those responsibilities are all there. But I think we can do a lot in the short term.

Van Dyke: There's one comment I wanted to make on what you just said. It seemed to me that in what you talked about, the most important thing would be the conflicting images of the future. The fact is that we just don't know how to talk about values at all. We just can't handle that.

One of the things you stated was that the environmentalists have to look at how fast they have become a force to be reckoned with...But if you stop and think about the way environmentalists have become a force to be reckoned with, they've done it by playing the sorts of games I talked about when I gave my speech, which is factual research. I don't believe that there's any such thing as completely objective research. Maybe more or less unbiased. But do you use facts, or are you for values? You don't argue values per se.

So I guess I didn't find your answer an answer, for me. Do you see any beginning of people being able to talk to each other about values, rather than if we put air pollution control on a plant, it will cut down heart attacks and we'll put a dollar figure on how much medical payment that will save each year, and compare that to the dollars that are used putting the air pollution controls on the stack. That's not really arguing any values, that's arguing dollars and cents.

Lee: Well, that is a kind of value, let's not forget that, first of all. That encodes a lot of values that are quite important to society.

The second thing is that I'd like to dodge your question slightly in the sense that I think the real concern is over this future business, about how we can envision futures for collectivities that are larger than our own families. I think we know how to think about, how to discuss what it is that we expect for our parents and our children and ourselves in the future. To a large extent, we have very positive images about where we are individually going to go in the future, and we expect success for our children and success for ourselves and so on. But we have very few ways of talking about success for whatever the relevant unit is. Success for Spokane, or success for the state of Washington or Oregon. Success for the United States. I'm not very sanguine at all that we can talk about those kinds of futures.

Question: I wonder if you would comment on how long you think it will take for the environmentalists to have less impact on the political process. You commented on the very rapid rise of environmentalists. What about the other side of that curve?

Lee: I would say that you can probably measure it inversely proportional to the unemployment rate. That's one way. If that goes up another point then environmentalists will fall with an elasticity....

Comment: There are a lot of environmental values that are contradictory. We're finding that right now in Oregon. We've got two candidates running for senator, both of whom call themselves environmentalists, both endorsed by many of the environmental organizations; in fact, one of them is very good on population and wilderness and the other one is very good on recycling and greenways, parks, something like that. It's not simple.

I think that interest in the environment has changed from essentially an interest in wilderness preservation toward an interest in air pollution, land use planning, all kinds of things. Perhaps the best thing we can do is keep adapting and adopting. I think, when we talk about environmental versus other values, it comes down to the value of short term success or immediate success versus long range success; and I think that's going to be the issue in the future rather than, say, specific air pollution policies.

LIVING ON A FINITE PLANET

Walter Bogan, Jr.

We've heard some specific and startling statements as to the dilemma we're facing. I am in the fortunate position of commenting on living on a finite planet. That could be disposed of in two minutes, or it could take us all a lifetime to address it with any reasonable degree of sensitivity. What I will do is comment on what I think to be a real dilemma in addition to the environmental one, and that is the one of communications. We've seen some evidence of it today. I'll comment on statements made by Congressman Foley, for instance, with regard to funding for education. I happened to attend a session a few minutes ago where people talked about the separation of fact and value. I'd like just to call your attention to some things that are in the press, and suggest to those of you not familiar with these authors and their ideas that you read them carefully, because I think they suggest a part of the dilemma.

On October 16 there was a meeting in Philadelphia at the Franklin Institute, at which one of the speakers was Dr. Jay Forrester from MIT. Many of you are familiar with Dr. Forrester's work, both under his own name and in the popularly translated "Limits to Growth" studies. Dr. Forrester on that occasion used as the title of his speech "The Limits of Growth Revisited."

According to the New York Times, Dr. Forrester said, "The goals of society are changing. Physical pressures have crossed over to the social realm, resulting in such things as increased drug addiction, crime, pollution, and war. We're at a point now where we must give up the idea that good is good in the ideal sense, and realize that what is good now may be bad in the future." He is further editorialized on by the person writing this article as having said that we have to look forward to an ethics of triage, explaining that this term, as used historically in wartime, means that we give aid only to those who have the best chance for survival. We develop a system in which we designate others as having little or no chance of survival. Consequently we don't address their needs at all. In response to that, there was an interesting observation and comment by a graduate student at Cornell, Cheryl Fox, who said, "My generation has a legacy of hope. For that reason I don't go along with the doomsday approach. For me,

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Ann Widditsch was the moderator for Session 20.

the beginning of wisdom is not in science and technology but in the value of human life."

Much of what we're dealing with in the environmental dilemma, whether it's in terms of our own domestic experience or internationally, is a failure of communication, a failure of common image, a common base from which we project idealized alternative futures. In the past three or four years we've seen a number of instances in which this has been brought to the attention of the public through things like the U.N. conference in Stockholm in 1972, more recently the population conference in Bucharest. However, to comment on the suggestions of Congressman Foley at this point, he said that we're talking to a limited number of people. That is, there are different perceptions held by different communities. There's the one community that argues that we have to have limits to growth both in population and in terms of economic growth. There is another, much larger, somewhat less vocal community that doesn't believe that any of these things are real, and they have faith in some other answers.

The reasons for suggesting that dilemma are very simple. That is to ask what mechanism do we have for attempting to establish a dialogue between those very divergent groups and what processes we have, at least in this country, for dealing with the "fact", that is the scientific fact, that rational perception of reality versus the values that people espouse. How do we put them together? I think we have, in addition to that doomsday perspective, some rational reason to have hope. I'm convinced that if we utilize some of the mechanisms that exist at the moment, we can move from that very polarized discussion to one in which we can talk about negotiating and arbitrating the kind of future that will consider a range of values.

There are two specific pieces of legislation that provide vehicles for addressing the fact - value dichotomy. One is the National Environmental Policy Act. The most important feature of that act, at least for our purposes as I view them, is that it requires public participation in the planning process, which is to say that a small group of planners or people with one set of values or one particular point of view, should in fact not make decisions affecting large numbers of people without an opportunity for some appreciation, a dialogue about what they view as the future they want to strive for. Additionally, we have in the passage of the Technology Assessment Act another possible vehicle, a device for planning. We have another means of projecting the future, and again the explicitly stated requirement that there shall be public participation.

Further, many states are now in an intensive process of planning, primarily around the land use issue. I would call your attention to the observations that Congressman Foley made about national land use planning, and why, in fact, is there no law? Why, in fact, there's little likelihood that there will be one at least in the short term? That is that we don't have consensus. We have a number of people who have values that they hold very dear, and their sense of their values is that they are reality-based. They are based on science, and what we want to do is to persuade larger numbers of people to this position.

The fact is, we have done an extremely effective job as evidenced by the extent to which this issue is one in which there's continual confrontation and polarization. As many citizen groups, particularly environmental groups, attempt to communicate to wider and wider sectors of the population what their perception of the problem is, what their purported solution is, and attempt to elicit the values that other sectors of the population place on these or conflicting things, we have a possible means of working ourselves out of the dilemma. I think the experience of interpreting NEPA is very instructive. We have a process by which we can arrive at consensus. We don't have to maintain a dichotomy of scientific facts versus values and create the impression in the minds of other people that their values are not considered important -- that's when the dialogue breaks down.

We can and should create mechanisms by which the developer is involved, the environmentalist is involved, and as broad a spectrum of the citizenry as possible, because the ultimate decision on all the issues that are of fundamental concern are not decisions on scientific or technical issues. They're not ones that scientists are going to be able to provide answers for, and even if they could, the citizenry would not be prepared to accept those answers as credible.

It was commented on earlier that credibility is a political quantity. We need to appreciate the extent to which it's not always sufficient to be right, that one must also be persuasive. The most effective mechanism for persuading is to develop strategies by which your position is put forward. There's ample opportunity for argument. At the same time, there is the opportunity for argument, dialogue, expansion from people who have an entirely different point of view. And it should not be viewed in terms of absolute persuasion on the one hand, but there should be open-mindedness and an attempt to understand that other person's point of view. Out of that kind of dialogue we can arrive at "consensus" and we can go forward. That's a very idealistic prescription; and it's very difficult. But it's the only one that I can see that addresses the variety of interests and needs, how we deal with competing interests. In my judgment, we're going to have to put a lot more emphasis on dialogue and attempts to resolve problems in a more constructive adversary situation than we've had. The courts provide one model, with the notion of rules of evidence.

One of the things that I was especially interested in in an earlier session was the observation that environmentalists came into political prominence with great speed. That is, the environmentalists were able to affect public policy as a force in the society in a matter of a few years. They came from nowhere to the ability to pass legislation. I asked, how long will it be before environmentalists are no longer a force in society, and are sloughed off as just another fad? The general tenor of society, both in terms of people's perception of their interests and the current economic situation, is going to force us to conscientiously and consistently explore strategies for solving differences, understanding differences and negotiating relief. There will be no either/or. We've had fairly high carbon monoxide levels in Spokane for the last few days, but I don't think anyone would have been in a tenable position had he suggested that Expo be closed down, that automobile traffic be curtailed, because there would not have been a very responsive audience.

These are the kinds of issues that we're going to have to work out strategies for dealing with, rather than one side saying, "We're going to discharge anything we want to without any attempt to understand what the implications are," while the other side says, "We're going to close that down because we don't like it." There is a great difference in people's perceptions of what constitutes an aesthetically desirable experience. It can be said categorically that the environmental movement (though I happen to identify with the issues undertaken) represents a very small sector of society, and is termed elitist by a number of people. It would be interesting to look at the number of citizens participating in conferences like this one who are not employed in some way in environmental activity. To what extent are we communicating effectively with the people who will be most affected by pollution control activities, for example, people who will be unemployed if a given plant closes down? What kind of relief will there be and what kind of dialogue are they going to be able to engage in? This is not a negative view. It is the only viable view, because even if environmentalists are right, if all their assertions are absolutely correct, they will still not be persuasive until a larger number of people are convinced. So the challenge is to go to those sectors of the community that don't now understand, appreciate or identify their interests as being consistent with the interests of this movement and establish a dialogue, whether it's in the union hall or the board room or in many, many parts of communities that some of us might not be particularly familiar with. It's only with that broad base of support that we're going to arrive at a just decision in which all interests are taken into account.

Another thing heard today was the question of what constitutes an environmental decision. It was suggested that environmentalists operating on their value structure define certain decisions as environmental. The observation was made that those decisions are indeed environmental to a degree. But in the main, they're human decisions to go forward with achieving human goals and purposes. A subset of that decision will impact on the environment. The extent to which we can sensitize people to concern for the impact that decision will have on the environment is the extent to which we will allow them to participate in achieving those things we want to achieve -- that is, this larger human decision, this larger purpose, at the same time assuring that the environment is protected. We can't do either of these things without utilizing all of the vehicles available to us.

We're particularly fortunate. I don't claim to know the legislation and the legal structure in countries around the world; but I don't know of any other country in which there is the direct legal requirement for citizen participation, the invitation for citizen involvement in policy formulation. What's significant is that as we talk about environment, we're really talking about policy formulation. All of the kinds of things we're concerned about have to be brought into some reasonable conceptual consideration with regard to the overall purpose, whether we're talking about transportation or energy or housing, any of these issues. So without belaboring it, I think it's appropriate to say that while we think there's a serious problem, there are not nearly enough people who have that persuasion. People think there are serious problems of various kinds. Not enough people think the environmental problem is as serious as environmentalists would like them to think. One of the observations that they would make is, "Well, that's a serious problem, but I've got many other serious problems that are not being attended to and I'm going to invest my energy in those."

The challenge to environmentalists is to demonstrate the extent to which that thing which they think is serious is indeed serious. However, the environment is indeed serious, and it's not unrelated to the other serious problems. And the extent to which we can build an "ecological" sense that goes beyond the basic biological ecological and think of social ecological is the extent to which we will grapple with some of these problems. Utilization of the existing mechanisms to the fullest is our first step and out of that citizen participation there is the likelihood that if more are needed, they will be generated, because there will be the consensus base which is the guiding principle for our decision-making process in the first place.

Now, just to comment very quickly on how that relates to the issue I'm primarily concerned about, and that is environmental education. I think what I've been suggesting is fundamental. That is, there are points of view, there are issues, there are ways in which one goes about getting answers to certain kinds of problems. I think we want to structure experiences for the adult public that will provide them with access to a variety of points of view, and allow them to look at what in their judgment is their primary interest and the public interest.

I think there are two items at issue. The concerns that we have about the environment in terms of the confrontation that exists in the society, the possibility for serious backlash, the relaxation of certain standards, laws, codes, or their deferral, is more likely to be reasonably addressed over the course of a few years by bringing about a different kind of dialogue with people who are in the adult working,voting age. The strategies that we would employ to better prepare future citizens are quite different, because the responsibilities and the requirements of formal education are quite different. I'd like to discuss those, but they should be discussed in a different context because these two issues, while not wholly separate, are quite different. I said at the outset that the topic was such that it could have been disposed of in 30 seconds or in two hours, or we could stay here for the rest of our lives. We are back and forth again with the values discussion, which we don't now have a discipline for dealing with except the public one which I think is quite effective. My concern is that we learn how to use it more effectively.

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